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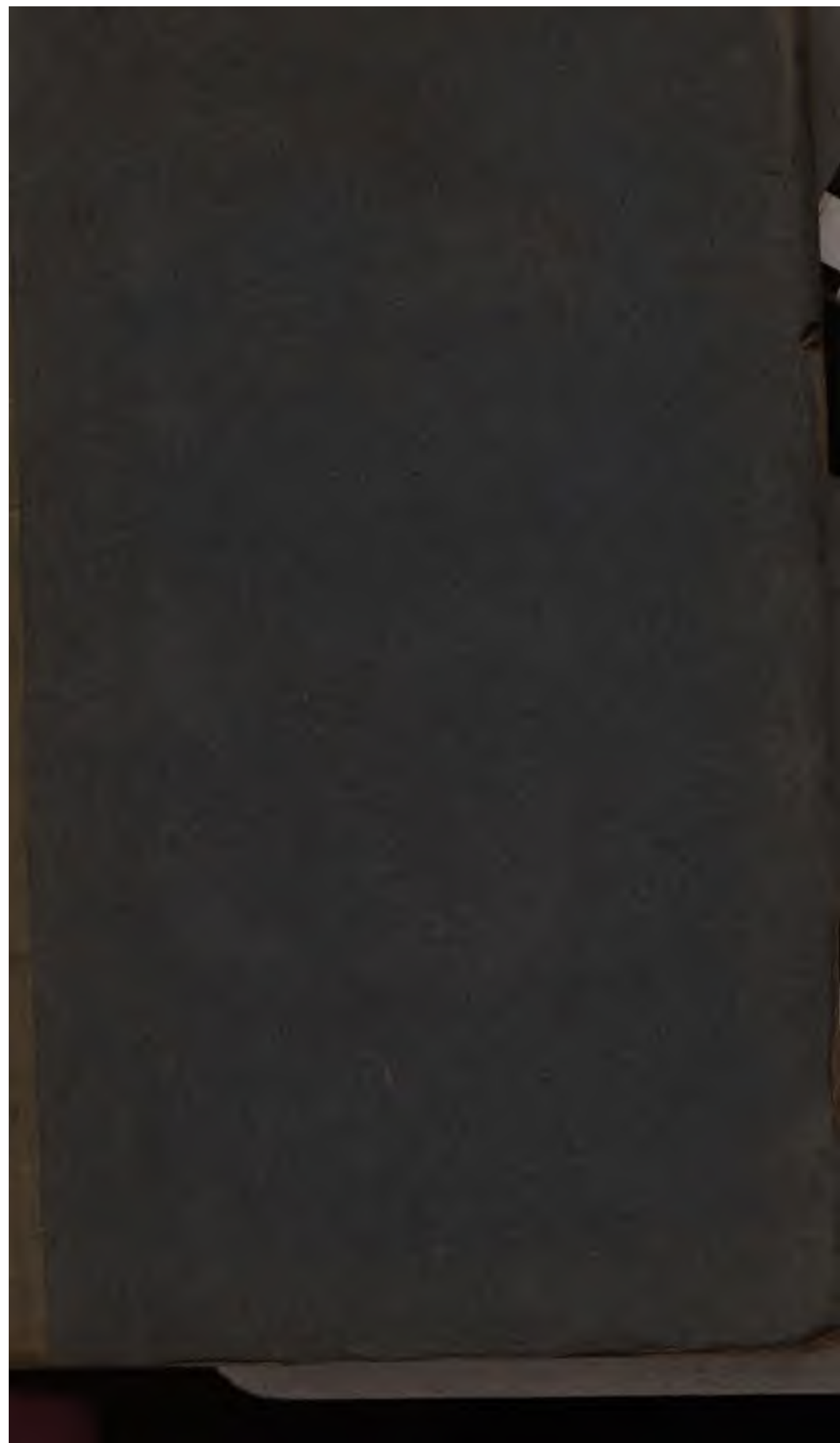
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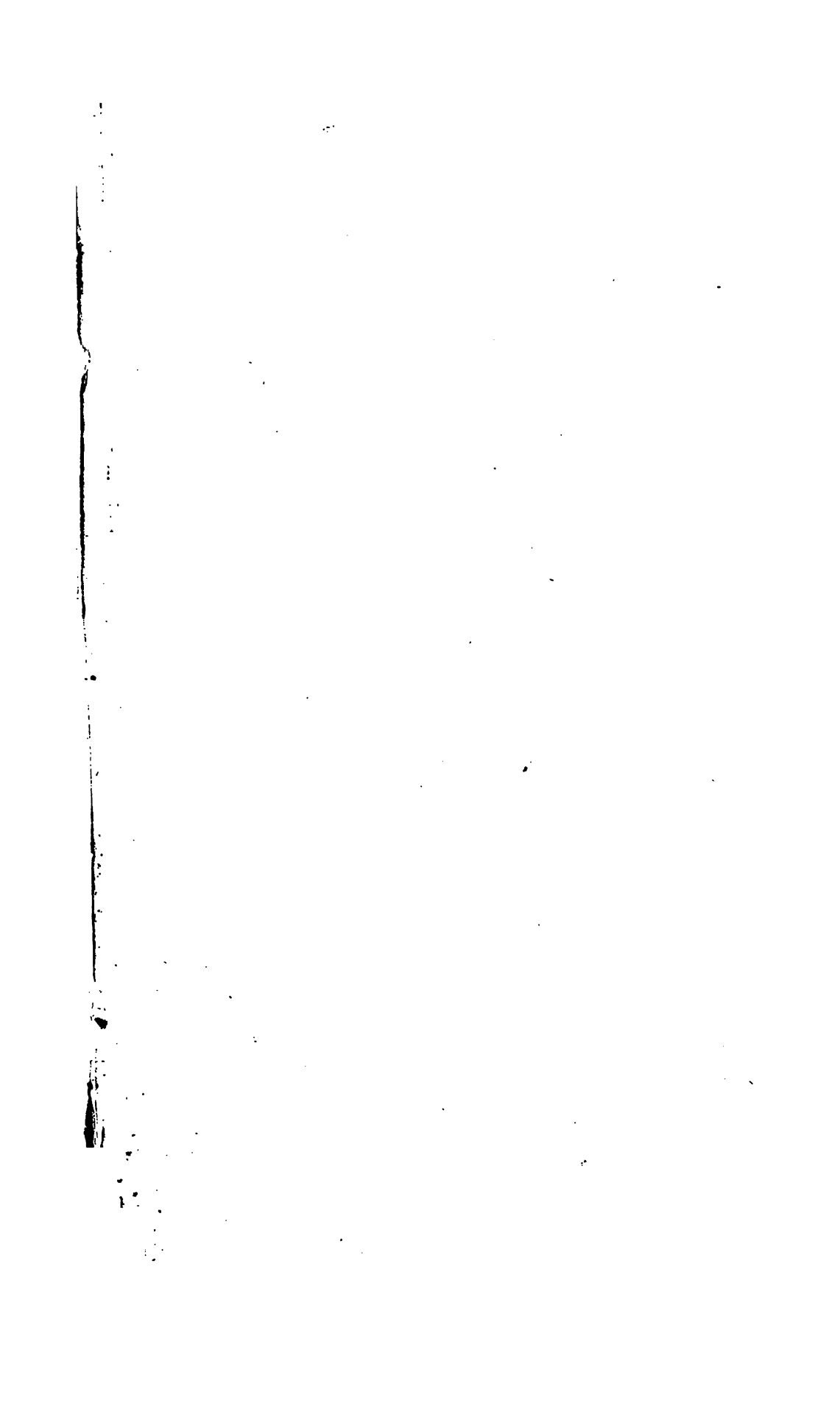
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PHYSIOLOGICAL VIEWS
OF THE
STRUCTURE, FUNCTIONS, AND DISORDERS
OF
THE STOMACH
AND
ALIMENTARY ORGANS
OF
THE HUMAN BODY,

WITH OBSERVATIONS ON THE QUALITIES AND EFFECTS OF
FOOD AND FERMENTED LIQUORS, AND ON THE IN-
FLUENCE OF CLIMATE AND LOCAL STATION.

By **THOMAS HARE, F.L.S. F.H.S.**
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Nunquam aliud natura, aliud sapientia dicit. — JUVENAL.

THE SECOND EDITION.

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TO
SIR JAMES EDWARD SMITH, M.D. F.R.S.
PRESIDENT OF THE LINNÆAN SOCIETY,
ETC.
THIS WORK IS INSCRIBED
BY ITS AUTHOR
WITH SENTIMENTS OF SINCERE RESPECT
FOR HIS SCIENTIFIC ATTAINMENTS
AND MORAL EXCELLENCE.

27, Argyll-street, London,
April, 1824.



PREFACE

TO THE

SECOND EDITION.

IN the first edition of this essay it was remarked, that “ since the obscurities of technical phraseology would in no degree recommend a work to the more liberal and enlightened members of the profession to which it relates ; and as the attention of others than medical practitioners is not unfrequently arrested by efforts which are calculated to simplify the objects of the healing art, I attempted to set forth my ideas in language as little technical as the nature of my subject would admit.”

In preparing a second edition, the flattering indulgence with which the former has been received encourages me to retain my original plan ; and further, to offer some remarks which I previously hesitated to introduce.

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EXPLANATION OF PLATE I.

- Fig. 1.—The ultimate fibre of muscle, showing its tubulated structure, longitudinal striæ, and transverse bands.
- Fig. 2.—The tube contracted, to show the qualities to which this structure is adapted. It would seem that an appearance of this kind led Dr. Croon to adopt the idea, that the ultimate fibre of muscle was constituted by a chain of bladders filled with fluid.
- Fig. 3.—Termination of muscular in tendinous fibre.
- Figs. 4 and 5.—The ultimate fibre of cellular tissue.
- Fig. 6.—Ultimate fibre of a minute conferva, to show its tubulated character.
- Fig. 7.—Ultimate structure of a minute parasitic fungus.
- Fig. 8.—The ultimate filament of fibrous tourmaline and asbestos, either of which is a solid prism, that of the former being sometimes articulated.

EXPLANATION OF PLATE II.

- Fig. 1.—A congeries of prisms, to show their possible influence on the net-like arrangement of bone.
- Fig. 2.—The tetrahedron.
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Fig. 6.—Commencement of the crystalline arrangement of enamel, to show the gradual compression of the globule as it proceeds from the neck of the tooth.

Fig. 7.—A double series of globules gradually becoming rhomboidal, and exhibiting an approach to the prismatic figure.

Fig. 8.—The enamel completed by an aggregation of rhomboidal prisms.

Fig. 9.—Section of a double tooth, showing the striated arrangement of its enamel and the laminated arrangement of its bone.

Fig. 10.—Diagram of one of the striæ, to show the universal adaptation of the rhomb to the structure of enamel.

Fig. 11.—A four-sided prism constituted by rhombs.

Fig. 12.—A common calcareous stalactite, showing the waviness of its surface.

Fig. 13.—Copy of an imperfect arrangement of enamel, in which the faces of three rhombs are seen in the progress of its decay.

Figs. 14, 15, and 16.—Stellated crystals which compose the snow-flake. Fig. 14 being more frequent than any other.

It is scarcely necessary to remark that the natural objects of both plates, with the exception of the stalactite, are magnified to such degrees as seemed eligible for a clear demonstration of the qualities ascribed to them.

PLATE I.



Drawn by Thomas Ilare

Engraved by J. Dury

London Published by G. & W. B. Whittaker, March 1856

PLATE II.



Drawn by Thomas Hare.

Engraved by J. Shury.

London Published by G & W B. Whittaker March 1874



!

STOMACH

AND

ALIMENTARY ORGANS.



CHAPTER I.

OF THE STOMACH AND NERVOUS SYSTEM, AND OF THE ALIMENTARY CANAL.

THE stomach is the great regulator of the whole animal machine, which, unoffended, it nourishes, if outraged, it disorders. It is not only the central repository of that nutriment which, by aid of the absorbent system, is extended to the remotest points of the ~~animal~~ frame, from infancy to manhood ; but it is also the source from whence, by an equally extending power of the nervous

system, the brain is influenced : and no mind has proper action, where the stomach is materially disordered.

To be satisfied of the immediate sympathy between the nerves of the stomach and those of the head, as well as of that sympathy which is so readily communicated from the remotest part of one member of the body to the remotest of another, it is only necessary to bear in mind, that nerves are no other than extensions of the actual substance of the brain, the principal of which extensions, commonly known as the spinal marrow, sends off branches to the extremities, and which divide and subdivide into filaments, ultimately becoming so minute on the organs of sense and motion as to evade the most scrutinizing research.

By means of the nerves, those organs which we are capable of calling into action at pleasure, appear to receive a direct influence from the brain with all the quickness of electricity; and although the precise nature of nervous fluid, or, in other words, of the medium by which this influence travels, is not understood, it would seem in certain

qualities to resemble electric fluid ; and Empedocles must have entertained an idea of this kind, when he advanced that fire, besides air and water, was contained in the nerves.

From the precise similarity of impressions naturally communicated to the nerves by corporeal irritability, and those artificially produced by the electric shock, it appears reasonable to imagine that the matter of nerve is furnished with elements in no way different from those of that widely extending power. The various degrees of electric influence prevailing in the atmosphere are acutely felt by the unfortunate subject of extreme nervous sensibility ; and in certain states of the air, the whole animal body seems trembling with the electric aura, as if under a charge of the ordinary machine. Certain fishes possess electric qualities in such an eminent degree, that they are capable of transferring a shock to another animal. The torpedo of South America is even said to convey a powerful shock through the medium of the line to the person who handles it : but the electric energy ceases altogether on the death of the animal.

Under these considerations, the sympathy between the stomach (to which a vast congeries of nerves belongs) and the remotest parts of the animal fabric, but above all that great director of its thoughts and actions, the brain, is easily reconcilable.

As this work is not addressed to the medical world exclusively, it may be excusable to observe that whenever the stomach is spoken of, the word is used literally, and not in conformity with the enlarged meaning of fashionable phraseology, which comprehends under that term the whole abdomen or belly, and the numerous organs contained within it: whereas the actual stomach occupies a comparatively small portion of the abdominal cavity, and forms but a very small one of the alimentary canal; the length of the intestines alone being always six times the measure of our height.

Although the alimentary canal, strictly speaking, includes the entire passage from the lips to the extremity of the intestines, the term is more commonly used to express only the stomach and

tract of intestines. Still however it may accidentally occur in the former sense: but my object is to make the entire alimentary canal a course for the progressive consideration of those organs which either expressly constitute a part of its own substance and apparatus, or whose collateral assistance is essential to its functions; attempting to relieve the monotony of detail by trifling digressions, as an apology for the introduction of such original views as my physiological inquiries have led me to adopt.

CHAPTER II.

CONCERNING THE MOUTH AND ITS GENERAL ORGANS—THEIR SECRETIONS—OF FERMENTATION IN THE STOMACH—AND OF CERTAIN CALCULI.

WHEN food is taken into the mouth, it has simply to undergo mechanical division from the teeth, assisted by the tongue and furrowed surface of the palate, and receive an admixture of saliva, which is a chemical medium of fitting it for assimilation with those fluids which are supplied to the stomach from other sources.

The lips, the inner surfaces of the cheeks, the palate or roof of the mouth, and its depending arch towards the throat, commonly distinguished as the soft palate, all receive their requisite degree of lubricity from small mucous glands, situate within a membrane common to the whole.

The uvula, which assists materially in the office of lubrication, and furnishes a convenient depending point for the deposition of mucus, may

be termed the glandular body of the depending palate ; from whose substance it receives a small muscle, which, from its spiral figure, is capable of much elongation and contraction. It is of great importance in deglutition, still more in speaking, and more than all in singing.

The tongue contributes to the necessary supply of mucus, and more particularly from its root, where numerous follicles for a due accession of it are stationed ; the sense of taste being seated in its point and edges.

Mucus is pellucid in proportion as it is watery, and more or less viscous as albumen is a constituent. These characters are modified altogether by the state of the stomach and intestines. It is supplied to all the membranes of the body ; but more particularly to those throughout the whole course of the alimentary canal. Mucus is the most abundant of all the secretions which the blood furnishes to the animal economy, and seems principally intended for defending the surfaces of membranes from the agency of such matters, as in the course of its functions must

8 OF THE MOUTH AND ITS ORGANS.

otherwise come in contact with them, and thereby exert a noxious influence.

A part of the papillæ, or those little white bodies so evident on the surface of the tongue, and especially backwards, are glands of subordinate office in the secretion of saliva, for each of which the cuticle forms a sheath.

The principal glands expressly destined for the secretion of saliva are three on each side the face ; namely, the *parotid*, occupying a cavity of the cheek at the lower and fore part of the ear, from which circumstance it takes its name (*παρα, near, as, the ear*) ; the *submaxillary*, which is much smaller, and so named from its situation within the foremost angle of the lower jaw ; and the *sublingual*, which lies near it, under the fore part of the tongue. The first of these glands forms numerous minute tubes, which unite into one common duct, terminating near the second grinding tooth of the upper jaw. The chief duct of the second or submaxillary gland, terminates near the small orifices which are formed by the third or sublingual behind the central teeth of the lower

jaw. These glands are all of conglomerate structure, the constituent glandules sending off excretory ducts, which unite in the manner alluded to for the transmission of the secreted fluid.

The motions of the jaws and tongue tend to promote the secretion of saliva, by the stimulus which their muscular apparatus communicates to the respective glands.

The saliva takes its name from the saline taste and qualities which it possesses: and its degree of saltiness depends wholly upon the state of the stomach. In a general way, we are not aware of saline agency from its constant presence; but unusual fasting, hunger from too rapid digestion, and an increased secretion from a relaxed state of the system, as in paralysis, all render it sufficiently evident. Saliva has further a combination of animal gluten, of ammonia, and of calcareous matter. While the teeth furnish the first *mechanical* step towards the digestion of our food, the saliva furnishes the first *chemical* step; and seems a chief agent of that fermentation by which digestion is eminently promoted, if not altogether effected.

The healthful condition of this most important secretion, is not only of the highest moment to the animal economy at large, but the saliva is often a medium for transferring diseases of various kinds, as is sufficiently instanced in the bite of a rabid animal, in the reprehensible and offensive practice of nurses tasting the food of children, and even the transfer of metallic influence, of which the following are examples.

I. A gentleman in perfectly good health, sat one hour by the side of another, who was under the full power of a mercurial ptyalism and unable to talk, amusing him with a lesson in botany. In the evening of the same day, he perceived some increase of salivary secretion, but made no account of it. In the night however it became very troublesome, and increased so rapidly, accompanied by swellings of the tonsil glands, and general irritation of the mouth, which previously were not in the least degree disordered, that he was confined to the house a full week; at the end of which time, the inconvenience had not altogether subsided. The taste of mercury had been con-

stantly present; and the impregnation of its vapour could not more successfully have been effected through any known means by design, than it was by this transfer through ptyalism from one individual to another. Mercury therefore must have been held in solution by the saliva, probably in the form of oxide; for the salivary effluvia could not have communicated the actual taste of the metal without an admixture of its volatile particles.

II. Where a faulty tooth in the upper jaw had been stopped from its side with a compound metal, the interstice between it and the adjoining tooth being quite inconsiderable, while the upper surface of a tooth not immediately beneath it in the lower jaw was stopped with the same material, a galvanic shock was regularly communicated by the saliva from one tooth to the other, whenever, by any accidental movement of the mouth, they came within a certain distance of each other, probably about half an inch.

The earthy matter which is, at all times, held

in solution by the saliva, not only shows itself in combination with animal gluten upon the teeth, but on some occasions it forms a distinct calculous concretion in the duct of the parotid, and other glands. A small deposition once established, furnishes a point for the more rapid accretion of that which is afterwards contained in the fluid; and in this manner the duct has been blocked up, and the saliva thrown out of its course, giving rise to fistulous ulcerations. Errors of diet seem to influence this morbid supply of earthy matter to the salivary secretion, as much as constitutional peculiarities.

We know that an earthy residuum succeeds the putrefactive fermentation of animal matter: and I conceive that the fermentation effected or at least promoted upon animal food by saliva and the other secretions concerned in digestion, whereby the alimentary mass is resolved into new elements, may cause an undue degree of earthy matter to be formed where animal food is used too largely. It is undoubtedly used by far

too largely with indiscriminate eaters ; and even the most moderate use more than nature demands for the general purposes of life.

I believe the formation of calculi of all descriptions to be especially promoted by such habits of body and habits of life as favour a morbid fermentation in the stomach ; and, above all, by the acrid, unassimilating, and acidifying qualities of fermented liquors and acescent food : and that the circulating mass may thus become charged with an undue proportion of earthy matter, which, through the medium of secretion, is detained in the reservoir of that particular gland, whose secretion possesses the greatest chemical affinity for it. The smallest conceivable portion having thus been deposited, furnishes a nucleus for the attraction and deposition of repeated laminæ, as is particularly instanced in that from the kidneys in their own ventricles, and in the urinary bladder. Gall-stones seem little more than indurated bile, which, for want of energy in its secreting organ the liver, and dilution of itself, has partially coagulated ; each body of coagulum,

no matter how small, furnishing a nucleus for subsequent accessions.

Earthy concretions from the lungs and from the salivary glands, have no determinate figure, nor even an approach to it. They are constituted, like the concretions alluded to, of amorphous lime, more commonly combined with the phosphoric than any other acid: and this circumstance alone shows an essential difference between the natural arrangements of health and disease; for the provident ordinations of divine wisdom appear to have assigned its own particular and characteristic figure to every species of matter howsoever minute; whereby the humblest molecules of lime, in the progress of their natural and healthful deposition in the animal body, arrange themselves by the same law as the gaudiest groups of transparent crystals within a massive rock; while, under the influence of disease, they are shaped only by attrition, where surrounded by fluid matter; for example, in the kidneys and the urinary bladder, after the manner of pebbles by the ordinary agency of water.

No animal secretion, perhaps, is less calculated than the saliva, to furnish us with satisfactory particulars for a standard of its chemical composition; for, unless obtained from the glands themselves, it mixes with mucus as soon as it enters the mouth; and both these secretions not only vary essentially in different subjects from peculiar habit of body, but they become impregnated with earthy, with acid, and with other matters of foreign quality, which are perpetually arising in the form of vapour from the stomach and lungs into the mouth.

The upper surface of the tongue furnishes a great medium of attraction for extraneous matter, by reason of its villous and papillated texture; while its main substance, which consists of muscular fibres running in infinitely various directions, serves to facilitate its different motions.

CHAPTER III.

OF THE THROAT AND ORGANS OF DEGLUTITION—OF THE DIAPHRAGM.

BESIDES the depending arch of the palate, already described, with which the uvula is considerably incorporated, and which by its central station gives origin to the figure of two secondary arches, another arrangement of the same figure, and constituted like the foremost of a double membrane with a few muscular fibres, sinks back from the uvula in a vault-like manner, to be connected with the pharynx. Between these anterior and posterior arches, are situated those mucous glands commonly known as the *tonsils*, and vulgarly as the “almonds of the ears;” an appellation which may be accounted for, in the deafness that frequently results from an enlargement of them, whereby they exert a mechanical compression on the apparatus connected with the internal organ of hearing.

The common circumstances of their relaxation, inflammatory augmentation, and consequent formation of abscesses, and their morbid secretion of mucus, are familiar to every one. The discharge of their secretions is effected by the action of the several muscular apparatus surrounding them.

From the posterior arch of the palate, a muscular funnel is formed, which has been named the *pharynx*, from its office of conveying food from the mouth into the stomach ($\phi\epsilon\rho\omega$, *porto*). Muscular fibres from every part of the mouth and throat are connected with the pharynx, contributing their united action to forward the progress of aliment to its destination. The top of the pharynx is open to the nostrils; whence it is, that by sneezing, hiccup, or any convulsive muscular contraction in the course of deglutition, fluids are sometimes forced into the nostrils.

Another troublesome accident not unfrequently attends deglutition, namely, that of portions of aliment "going the wrong way" as it is commonly and not improperly termed. The fore part of the pharynx is constituted by a membrane which also

forms the back part of the *larynx*, or cartilaginous funnel of the trachea or windpipe, and so called, probably, as an important part of the organ of voice ($\lambda α ρ υ ζ ω$, *clamo*). It is very conspicuous in the necks of men, is situated immediately before the pharynx, and has a small elastic valve for defending its aperture, which is naturally closed in the process of deglutition. A slight irregularity of muscular action in swallowing sometimes disturbs the office of this valve, when the admission of the smallest substances into the trachea occasions a sense of choking, which is only to be relieved by the natural effort of coughing; since the reputed advantages of emetics, sternutatories, and expectorants, are altogether nugatory.

In the same manner as the tube proceeds from the bottom of a funnel, the canal termed *esophagus* descends from the pharynx into the stomach. The future tense of the same verb which gave origin to the word pharynx, has, for similar reasons, been had recourse to for compounding the term *esophagus*; namely $ο ι σ ω$, with the aid of $φα γ ω$, *to eat*. Thus, it will be seen that the terms

pharynx and esophagus express nothing more than the office of a muscular inverted cone and its tube for conveying aliment from the mouth into the stomach. They were conjointly named *infundibulum* by the Latins, as expressive of the common figure ; and in English the gullet; from the Latin *gula*, which term seems to have been applied exclusively to this apparatus.

The esophagus, as well as every other tube-like apparatus of the alimentary canal, is formed of different coats, which are specifically distinguished.

The external coat, consisting of cellular tissue, serves to connect it with all the adjoining parts. Next to this is a series of muscular fibres running longitudinally, which, according to their direction, are capable of contracting and elongating the passage in the course of deglutition ; while another orbicular series, placed transversely within these, furnishes the means of contracting its diameter.

It is from the irritation communicated by solid matters of food which have not been properly masticated, that these muscular fibres are caused

to contract, and occasion choking. They are further subject to spasmodic contractions from hysteric affections, nervous irritation from wounds, obstinate flatulence, and various disorders of the stomach.

When foreign bodies occasion a constriction of the esophagus, it is more frequently eligible simply to force them into the stomach than to make any attempt at dragging them up. If they be matters of aliment only, the functions of nature will afterwards carry them off, provided no material disorder of the stomach and tract of intestines prevail; or, if they be of an indigestible kind, active purgatives would be administered as a matter of course.

The esophagus has next another layer of cellular tissue, which anatomists have called the nervous coat, whence it would be imagined to consist strictly of nerve: but as this is not the case, the term is objectionable; its real nerves being mere ramifications from those of the chest, a very important nerve of which, connected intimately with the brain and stomach, forms a sort of net-

work upon it. The inmost coat of this tube is a delicate membrane continued from the mouth, appearing plaited longitudinally while the passage is relaxed; but losing that character when it is dilated. It is abundantly furnished with orifices for the supply of mucus, not only from its own glands, but from others of neighbouring station and of greater size, which communicate with it; for instance, those seated on the spine and near the larynx.

The esophagus descends between the trachea and the spine, and after a slight undulation passes through the muscular substance of the diaphragm, and connects itself with the upper opening of the stomach, the situation of which opening is near about the sixteenth articulation of the spine.

The viscera contained in the chest, or thorax as it is technically called, and those contained in the abdomen or belly, are divided from each other by a firm muscular and tendinous partition termed the diaphragm or midriff, both of which terms imply its office as a medium of division (*διαφρασσα*). It may be said to form the floor of the

thoracic cavity, the membrane common to the lungs being extended over its upper surface, which is here convex, the centre of the convexity reaching to about the fourth pair of ribs ; while its concave under surface, forming the roof of the abdominal cavity, has also an expansion of the membrane common to it, and which is termed *peritoneum* (*περιττω*, to extend round).

The diaphragm has certain perforations for the transmission of different vessels and nerves, besides that for the esophagus into the stomach.

The diaphragm is of the highest importance to the function of respiration. The inhalation of air causes it to be drawn downwards by contraction of its fibres, so as to enlarge the cavity of the chest, and lessen that of the abdomen. In exhalation, on the contrary, it is drawn upwards, enlarging the cavity of the abdomen, contracting that of the chest, and forcing out the air from the cells of the lungs, after it has served its destined office to them. Thus, during life, the alternate rising and sinking of the diaphragm in time with our breathing is incessant. It seems

nearly as likely that the term thorax was applied to the chest from this circumstance, as from that of the constant motions of the heart (*ῥογήσας*, *to leap*). The action of the diaphragm lifts the whole substance of the lungs, while that of the heart, although its influence is extended throughout the system, is more limited in the chest.

Ventriloquists avail themselves of the enlargement of the thoracic cavity during the inhalation of air, for those alterations of voice which may be effected at such a time. Practice, it is well known, enables them to modify their tones according to various distances, so as to convey the idea of their issuing from particular objects; and it is very likely, that the oracles of Egypt, Greece, and Rome, were made to deliver their prophecies by a priestcraft of this kind. The temples were furnished with secret cells or chambers, from whence the sacerdotal ventriloquist directed his voice to the head of a statue. Of such a place the Temple of Isis at Pompeia, among others, furnishes an example.

Having spoken frequently of muscular fibre,

and its powers of contraction and relaxation, as well as of cellular tissue, and membrane, it may be fit to consider their respective natural characters, before any thing further is said of the organs which are constructed by them.

CHAPTER IV.

NATURAL HISTORY OF MUSCLE—ITS COM-
POUND FIBRE—ULTIMATE FIBRE—OF TEN-
DON AND ITS ULTIMATE FIBRE—MUSCULAR
MOTION—STRUCTURE OF ARTERIES—CEL-
LULAR TISSUE—OF MEMBRANE.

ALL the movements of the animal machine are effected by masses of flesh, which have been named muscles, probably from *μυσιάν*, *respirare*, because their alternate relaxations and contractions resemble the motions of breathing ; and it cannot have escaped the most superficial observer, that these organs are made up of fasciculated fibres, which, possessing in an eminent degree the qualities of constriction and relaxation, are capable of performing all the varieties of animal motion, according to their particular arrangements.

Of the individual muscle, one end, distinguished as its origin or head, is commonly attached to an immoveable point, while the end that is fixed

to the point or points to be moved, is distinguished as its insertion or tail, the chief fleshy substance being termed its belly. These notations appear to have originated from an idea of very distant times, when similes of the most ridiculous familiarity were adopted, that a dissected muscle resembled a flayed mouse; and accordingly it has been thought that the Latin *musculus*, after the Greek *μυοειδης*, furnishes the etymology of the word muscle. The extremities of nearly all the large muscles are tendinous; the substance of tendon constituting a more dense and convenient medium of union with cartilage, ligament and membrane.

The length, breadth, massiveness, expansion, and general dimensions of muscles, are proportioned to the degrees of power they are required to exert, and to the bulk, structure, or weight of the organs to be moved; their main fibres tending collectively towards the insertion. Certain muscles are opposed to others for the purpose of moderating various degrees of action; and, by his book *De Fracturis*, it appears that Hippocrates

was the first who insisted on the importance of observing the direction of muscular fibres in the treatment of fractured bones.

In proportion as muscles are long or short, their powers of contraction are greater or less ; while the force they are capable of exerting is in proportion as their fibres are numerous or extensive.

Contractile action is effected by a shortening of the fleshy fibres only, the tendinous possessing no such power. Thus, it is the body of the muscle only which causes its extremities to approach nearer to each other ; in which office it becomes much harder, swells considerably, and continues to swell in proportion as the exertion is continued. In proportion as the contraction is powerful, the sensibility of the muscle is lessened ; and it is from this circumstance, a variety of silly tricks are practised by the vulgar, such as running pins into the legs and arms, and similar foolish conceits. Massive muscles, notwithstanding, do not possess the power of contracting in so eminent a degree as those which expand themselves in a series of fibres ; they are naturally less irritable.

The diaphragm is the largest and most important muscle which falls within the province of our present considerations, and no muscle of the whole frame is better calculated to exemplify the character of muscular and tendinous fibres in general.

Fibres, however, which in the general appearance of an aggregate, constitute all the great individual muscles of the animal frame, are themselves of compound structure, an examination of which will tend greatly to illustrate their particular qualities of contraction and relaxation, a circumstance necessary to account for the contractibility and convolutions of the stomach and intestines.

Those fibres, by the general direction of which each particular muscle is characterised, and which divide of themselves, according to their longitudinal arrangement, I would venture to call *compound fibres*, in contradistinction to the secondary or *ultimate fibres* of which they are composed, and on the particular nature of which their mechanical qualities depend; for, if the structure of what is commonly called a muscular fibre were of a

dense substance, it is impossible it could admit of elasticity.

It becomes necessary, then, to look for the provision which nature has made for the exercise of muscular elasticity. beyond the general character and arrangement of its compound fibre: and this will be found in the ultimate fibres, which, in an aggregate, may be clearly demonstrated to make up the compound fibre, without any such stretch of magnifying power as can possibly mislead the ordinary perceptions of the eye: and under these considerations, it seems unaccountable that Leuenhoeck and others should have believed muscular fibre to be divisible *ad infinitum*.

The "*molecules organiques*," which, at one time, were great objects of speculation with the French physiologists, were adduced with a view to demonstrate the primitive fibre of muscle, as globular, spheroidal, and rhomboidal.

In the field of a moderately powerful microscope, however, it is sufficiently evident that a fleshy fibre is made up of numerous minute tubes, each exhibiting longitudinal striæ, with trans-

verse bands much like the structure of the esophagus already described, the average diameter of each of these ultimate fibres, or tubes, being the four hundredth part of an inch (Plate I. fig. 1, 2).

The raw ultimate fibre has a solid appearance, but after exposure to heat, the apparently adipose contents become liquefied, and the tube exhibits the characters which have been described. Of course, the diameter of an elastic tube is diminished in proportion as its length is increased; the diameter being increased as the length is diminished. Hence, in the aggregate, an admirable provision is made for the contractibility of muscles, and the swelling of their general masses in a state of contraction sufficiently explained.

An opinion has been adopted that the fibre of tendon is no other than a continuation of muscular fibre, assuming a new character from its more compact structure. Whatever the difference of *substance* may be, it is sufficiently evident that the *structure* is different. The ultimate tube of muscular fibre terminates obtusely, and ceases to be hollow, uniting with filaments of tendon, which

are dense, of infinitely smaller diameter, and which in a reticulated manner constitute the main fibre of tendon (Plate I. fig. 3). These filaments further appear to unite themselves, for some considerable way, with the substance of the muscular fibre, so as to render their attachment the more secure. The reticulated structure of tendinous filament is undoubtedly of great advantage to its union with particular substances, such as cartilage and ligament; and its density no less so, in consideration of the yielding quality of the muscular tube.

These differences of construction between the ultimate fibre of muscle, and the ultimate fibre of tendon, serve sufficiently to explain why the fleshy part only of a muscle is capable of contracting, while its tendinous portion has no other motion than that of following the bone or whatever other substance is to be moved.

The tube-like structure of the ultimate fibre gives the muscle a much greater advantage in point of power, than if the compound fibre were constructed of dense elastic matter. Under an

idea of the experiment affording some illustration of this circumstance, I have found that a tube constructed of elastic gum, or India rubber as it is commonly called, requires a much greater weight to break it down, a vastly greater force of any kind to solve its continuity, than a flat piece of the same matter precisely corresponding in length and thickness, and of breadth more than equal to the circumference of the tube.

In the structure of muscle, therefore, the same wise arrangement of nature is to be remarked as in that of bone. All the cylindrical bones of the body are hollow, a circumstance which not only gives them the advantage of being much lighter than they would have been if constituted of a dense texture, but gives them vastly the advantage in point of individual strength and power of support. This fact may be illustrated by a very simple experiment, viz. If a solid cylinder of glass be placed horizontally, so that its end shall rest upon two perpendicular supports, and if a hollow cylinder of glass be disposed in the same manner, it will be found, on attaching weights to the central

part of each, that a much greater power is required to break down the hollow cylinder than that which is impervious.

Muscles are abundantly furnished with arteries, veins, and nerves, which insinuate themselves by minute ramifications between the ultimate fibres; and their red colour depends wholly upon the blood which is supplied to them, of which a proof is furnished by the paleness of a living muscle after it has bled largely from incision or any similar injury.

Muscles on the average have the power of contracting one third of their length; and the transverse contraction, of which the ultimate elastic tube is susceptible, affords an admirable accommodation for that degree of compression, which contractile action must of necessity cause. The general compression at the same time exerted on the filaments of nerve, serves also to explain why muscles are less sensible in proportion as they become contracted; as was instanced in a general way, when speaking of their natural properties. To mention another example: wounds

are often inflicted in the field of battle, which are not felt during a desperate conflict, solely on account of the high muscular energy of the part which is in force at the time.

Impostors sometimes avail themselves of the diminished sensibility produced by muscular contraction, for the attestation of credulous persons ; and it is astonishing to what ordeals they will submit. I remember a young rustic who was impressed for military service after having enjoyed perfect health throughout his life. Abhorring the idea of a soldier's avocations, but being destitute of pecuniary means to procure a substitute, he feigned convulsions upon the most trifling occasions ; and during their assumed influence, suffered the most flagrant liberties to be taken with his person, such as running pins and needles into different parts, applying hot irons, and various modifications of torture, which were practised by his observers to their great disgrace. His object being attained, and some considerable time having elapsed, he appeared in perfect health, and acknowledged the imposition.

It is from the over contraction of the muscles which are principally concerned in forming the calf of the leg, and which collect their fibres into a long tendon, attaching itself to the bone of the heel, that violent exertions in dancing cause the tendon to rupture; and the accident, which is not uncommon, furnishes an example of the advantage, in point of power, an assemblage of fleshy fibres which are elastic has over that of tendinous fibres which are not elastic; the substance of the latter, in this instance, seeming very disproportioned to the bulk of the former. The tendon under consideration, whose express action is to raise the heel by following its muscular body, has been named the tendon of Achilles from being especially concerned in feats of agility; or according to the story of Thetis, from the heel being the only part in which Achilles was vulnerable.

The high vascularity of the muscles favours the accession of rheumatism, which may be regarded as an inflammation of their fleshy substance, and thence communicated to the tendons. To the circumstance of the joints forming fixed

points for the attachment of muscles, whose powers of resistance are opposed to each other, may be referred the stiffness and acute pain which they experience under its influence; for although the muscles be painful throughout, the extremest degree of pain is felt at the joints.

I am inclined to believe that although a circumscribed accumulation of blood is evident in inflammation, the vascular obstruction is not produced by any muscular apparatus which the arteries themselves possess, but rather by a contraction of those muscles or parts of muscles through which their branches ramify. Having often sought, in vain, for the reputed muscular coat of an artery, I am led to conclude that the whole tube is constructed of cellular tissue, which from its different degrees of density or compactness, appears to form separate coats; and which from its yielding powers, is fitted for all the purposes of circulation by the impulse which the blood receives from the heart alone, the great muscular power of which appears more than sufficient for propelling it through elastic tubes to all parts of

the body. But besides the contractions alluded to, of individual muscles or portions of muscle around vascular branches, inflammation often results from a defective power of the heart to propel the blood forwards. Thus opposite causes produce similar effects locally.

Every muscle is furnished with its proper membrane, by that omnipresent substance of the animal body, named *membrana cellulosa*, and perhaps still more appropriately by the French, *tissu cellulaire*. In separating the muscles, minute filaments of this cellular tissue are seen proceeding in a reticulated manner, gradually becoming more fine, to bind their ultimate fibres together, but in the tendons it has little or nothing to do; for the net-like arrangement of their own filaments renders such assistance unnecessary. Each filament of cellular tissue, the average diameter of which is not more than the thousandth part of an inch, appears in the field of a good microscope to be a tube, admirably adapted to elastic power in common with the ultimate muscular tube. When unextended, it exhibits numerous

transverse striæ or contractions, after the manner of an intestine; and when extended, abundant traces of the attachment of other filaments (fig. 4 and 5, plate I). Possessing lubricating fluid, it prevents injuries from friction, while it facilitates muscular action, and constitutes a convenient net-work for the lodgment of fat, which fills up the interstices of the great muscles, and gives evenness of surface to the body at large; the elasticity of its tubulated structure accommodating itself to the different degrees of fatness or emaciation which are influenced by variations of health.

It is this cellular tissue which is employed by nature, to repair the injuries of muscles when their substance has been cut through; for it does not appear that the fibres themselves are capable of uniting, after they have been divided by incision or laceration in a transverse or oblique direction. Although the constituent materials of bone are ever ready in the animal economy, for repairing the injuries which the skeleton may experience, even to the regeneration of an entire bone, and although the several materials which

have hitherto been detected in muscle appear to be no less constantly renewed, no instance is known of a lost muscle having been regenerated. Still the causes which operate in effecting the decay of bone appear also to operate in effecting that of muscle.

It must be remembered, notwithstanding, that the individual substances of bone and muscle are of different nature and different office; and I humbly conceive, that while the ductile cellular tissue effects the repair of injured muscle, it is not concerned in the repair of bone, respecting the apparent crystalline arrangement of which some ideas will be offered in considering a future subject.

The tubulated nature of cellular tissue and its elastic qualities appear to render it sufficient for the construction of all that vascular apparatus, which obeys the muscular actions of the heart. It explains, too, why air passing under the skin may cause flatus to extend through a great surface of the body, while those partial contractions of the tube which have been alluded to, explain

also by what means it accommodates itself to the rigidity or the relaxation of particular parts, or of the system at large. Cellular tissue varies in density according to the office it is required to fill; the tube frequently bulging into the form of cells varying in their capacities. In conformity also with the nature of its office, this substance seems to contain either oily, gelatinous, or mucous fluid.

The natural history of cellular tissue gives also that of membranes in general, which are more or less dense according to the diameters of their fibres, and more or less supplied with lubricating fluids in proportion as their stations require it. They are named in an arbitrary way, expressive either of their arrangement, or of the different substances they are destined to defend, to construct, or to lubricate; being abundantly furnished with blood-vessels, nerves, absorbents, and glands.

CHAPTER V.

FURTHER CONSIDERATIONS OF MUSCULAR MOTION—BONE—ULTIMATE VEGETABLE FIBRE—ULTIMATE MINERAL FIBRE—COMPARATIVE PHYSIOLOGY.

THE substance contained in the ultimate tube of muscular fibre seems like that in many forms of cellular tissue, to be adipous, since it is abstracted in an oleaginous form by heat, leaving the tube distinctly characterized; and it would not appear that the lubricating contents or qualities of the cellular tissue alone were sufficient for that easy and undulating motion which the extreme fibres must at all times be ready to exert among themselves, in obedience to the sudden impulse of muscular exertion.

The stimulus directly communicated to the substance of individual muscles seems strictly to be effected by those ramifications of nerve, which they so abundantly possess; and when it is considered, that these extensions of the identical sub-

stance of the brain receive their impulse through an electric medium, the circumstance would appear to account for the rapidity, with which the dictates of the will are transmitted to the muscles at large.

Swammerdam thought that the force of arterial blood communicated action to the muscles, after receiving its stimulus from the nervous system. But the irritation of which the nerves are susceptible, even after death, by galvanism and other exciting media, so as to create powerful muscular contractions, favours the idea, that the exciting powers of the nerves during life, depend upon an electric property, and that the vascular system has no primordial influence upon the faculty of muscular action.

The undulating motions of the muscles very much resemble those of water, a quality which explains itself in the opportunity their ultimate fibres naturally possess, by reason of their structure and arrangement, of moving freely in a longitudinal direction one with another, and which their own elasticity as well as that of the cellular

tissue binding them together admits of, with the aid of that lubricating matter with which both are supplied. The quantity of space in proportion to the quantity of matter is sufficient to allow of an approach to the undulating motion of water; bodies being more fluid in proportion as the quantity of space is greater than the quantity of matter, whereby their constituent particles are enabled to move in a corresponding ratio among each other.

Where the animal body becomes emaciated from long continued disease, the diminution of bulk is more than equal to that of the adipous substance, which fills up the spaces between the muscles, and gives regularity to the form: in other words, the waste seems deeper seated than in the common cellular integument, notwithstanding its thickness; and as a diminution of bulk cannot take place without a diminution of substance, it becomes necessary to look for that extra degree of bodily exhaustion beyond the limits of what, in vague and general language, is called the cellular substance; and the diminu-

tion of the adipous matter contained in the ultimate fibre of muscle appears to furnish the balance of the account. After nature has so far exhausted this store, as to leave only sufficient for the indispensable offices of life, she has recourse to the marrow contained in the bones for supporting its powers, either until resources fail altogether, and existence is terminated, or until the return of health furnishes new means of supplying nutriment.

It is questionable, whether the fat of the common cellular integument is destined for nutritive purposes. In some instances, it appears only a protection for organs which are of active service; in others, little more than a cushion. In excess, it is a disease of itself, the progenitor of various maladies, and communicates a morbid degree of acid to the fluid secretions. Such an excess of acid favours the production of calcareous accretions, not only in the reservoirs of the animal fluids, but even at the joints of the bones, as is exemplified in the subjects of gout. In all gross habits, there is a morbid preponderance of acid,

and its influence on the formation of calculous concretions has been adverted to in the second chapter.

The marrow contained in the bones seems to be the very last resort of declining vital power. It is less ready of access to the circulating system than the oily, adipous, or gelatinous matter contained in the several structures of the soft solids. The bones, therefore, in addition to their being the great mechanical support of the animal body, are also the defence of its last store of nutriment. In youth, the blood vessels by which it is deposited are far more distinct than in middle life, when it becomes more oily. In every advanced age, and in some forms of disease, it is scanty and watery, whence the bones are rendered brittle.

Though vegetables are not possessed of locomotive powers, they have notwithstanding considerable degrees of motion in certain of their organs; and such as, approaching those of animal muscle, seem to depend on similar causes. That the exciting cause of muscular contraction in vege-

tables is of an electric nature seems probable from the physical properties of the elements which surround them, and of which they may be supposed to partake, namely, the electric qualities of the atmosphere, and of the metallic matters contained in a greater or less proportion in every soil: the medulla or pith, which may be regarded as the nervous system of vegetables, appearing a convenient medium for collecting and diffusing electricity.

On examining the extremest fibre of a soft vegetable body, it will be found to correspond in its tubulated structure, with the ultimate fibre of animal muscle. Many *confervæ*, both of the sea and fresh water, which to the naked eye appear to be only a congeries of minute dense filaments, exhibit in the microscope a tubulated structure, furnished with transverse septa, which apparently constitute an apparatus for the offices of contraction and elongation, like that described in the ultimate fibre of animal muscle. (Plate I. fig. 6). The fibrillæ of numerous parasitic fungi,

which also appear dense to the unassisted sight, are demonstrated by the microscope to be tubular, and very commonly furnished with spheroidal processes, which probably are glands (Plate I. fig. 7). Beyond these hollow fibres, none are to be traced which seem impervious.

Thus, it appears that the ultimate fibre of the animal and vegetable kingdoms is constituted by a tube adapted to exercise the especial functions of contractibility and relaxation, upon the communication of a stimulus from an exciting cause. Whoever is attached to vegetable physiology will readily call to mind those modifications of muscular action which are so conspicuous in *Mimosa pudica*, *Dioncæa muscipula*, and *Stylidium globosum*.

The medulla of plants bears a very considerable analogy to the spinal marrow of animals ; and if, according to Mr. Lindsay, it is to be demonstrated in the leaf stalk of the sensitive plant as the seat of irritability, (and in coincidence with Sir James Edward Smith, I cannot "see any thing to invalidate the idea,") the medium

through which an exciting impulse is conveyed to the vegetable muscular fibre resembles strictly that of the animal economy.

A plant which has been removed from one spot to another droops through relaxation of its muscular apparatus; which has lost the stimulus usually supplied to it, until the gaseous and nutritive constituents of the new soil shall have assimilated with its circulating fluids! But as soon as the plant is capable of absorbing moisture and nutritive matter from the soil, the necessary degree of stimulus is communicated to its muscular fibre, which contracting gives the same air of vigour to the refreshed vegetable as food and drink communicate to the fatigued animal.

Smoothness, rotundity, and gentle undulation of outline are characteristic of perfection in animals; and in vegetables, the same qualities are to be remarked in a lower gradation, until existence is on the wane: but in the aged man, and in the aged tree, these attributes begin to disappear, and giving way to angularity and harshness of outline, a step is made towards that inorganic

kingdom, with which they are about to be assimilated, for the purpose of contributing to the nutrition of their own species in after generations.

From the clouded peak of Chimborazo in gradual progression to the minutest grain of sand upon the level shore, from the basaltic pillars of Staffa to the finest filament of asbestos, a regular crystalline arrangement is to be traced ; the generalizations of which, characterize every elevation of the earth's surface, and the individual peculiarities of which descend from the most splendid and geometrical crystals to the most minute and apparently irregular of all mineral bodies ; reminding us that the Supreme First Cause of all has made ample provision against the possibility of any thing arranging itself by chance.

Whatever degree of elasticity any of the members of the mineral kingdom may possess, whether it be the air of the atmosphere, or water, or any solid substance, it is proportioned to the cohesive aggregation of its constituent particles : and while the ultimate particles of fluid matters seem, by their peculiar qualities, to be globular, those of

the solid have an endless variety of geometrical configurations under plane surfaces and solid angles, of which the most prevailing are simple and demonstrable. But the comparison of the ultimate mineral fibre alone, with those of the animal and vegetable bodies, will show why it can possess no elasticity of itself; for the very finest mineral filament, and such as, in fasciculi, can be manufactured into cloth (and which manufacture was adopted by the Romans for wrapping the bodies of their illustrious dead), will show itself to be a solid prismatic crystal (Plate I. fig. 8), and consequently endued by nature with no such properties as the ductile tube of the animal and vegetable fibre. Electric agents call forth no such convulsive or contractile powers in the mineral, as in the animal and vegetable fibres: and whatever alteration it undergoes, must be either by resolution into its own elements, or by a new combination according to the laws of attraction. Thus the lime that is deposited in the cartilaginous skeleton of infancy, and which continues to be supplied until the full stature of man is perfected,

arranges itself according to a law of this kind : and although the crystalline arrangement which is observable in the progress of its healthful deposition disappears altogether in the animal machine when perfected, yet certain kinds of chemical influence in the progress of disease cause it to re-appear ; and this is but a modification of what takes place in entire rocks ; for it often happens that when a quarry is worked through a solid mass, individual stones, which have been separated in the ordinary way, either fall to pieces after they have been exposed for a short time to the air of the atmosphere, under regular crystalline figures, or else go into cracks, which are strictly referable to the characteristic crystal of their peculiar constituent matter, as may be abundantly demonstrated in carbonate of lime, in basalt, sandstone, and several other substances. Similar phenomena in the animal machine will be spoken of in the natural history of the teeth.

Solidity is but another term for crystallization ; and all natural bodies are more or less solid in proportion as they approach the crystalline structure.

The perfected bones of man, and of the higher orders of animals, constitute a firm, compact, and unyielding frame-work of earthy matter, with hinge-like, rotatory, and sliding articulations; the sole offices of bone being those of mechanical support and mechanical protection to the softer parts of the body. The teeth, which are the only hardened earthy parts of the animal frame exposed to the influence of air, to the influence of invasive fluids, or called upon to exercise any sort of mechanical power without the intervention of membranous or other protection, and without the aid of lubricating fluid proper to themselves, or being placed beyond the mutilating influence of chemical agents, are of a more dense, refined, and minute crystalline texture externally than any other of its objects: but this natural advantage of texture has become progressively lessened with the advancement of civilization, which has so materially deteriorated our general objects of aliment.

Trees and plants, by their natural habits, require no change of place for fulfilling their wants, necessities, or inclinations. Wood therefore is

less solid than bone, and requires no accommodation for flexibility or any kind of motion at its joints: and all vegetables, from trees down to the lowest plants, are capable of retaining more or less nutriment in proportion as their fructifying organs are at a distance from the soil by which it is furnished. Their whole structure consists of tubes and cells destined for various offices, and closely resembling the general apparatus of the animal economy. Like animals, they retain throughout life a higher temperature than that of the surrounding air.

Muscles may be said to possess certain qualities, the intermediate of solids and fluids; for the solidity of their constituent substances may be regarded as one step towards crystalline conformation; while the motion they admit of by their yielding qualities, the movements of their component fibres with respect to each other, and the proportions of space to those of matter, represent, in the aggregate, a quality approaching to that of fluidity, furnishing a convenient medium for the transmission of electric, or at least modifications

of electric agency from the sensorium to the remotest moving powers ; the earthy solids, ~~the~~ soft solids, the gelatinous fluids, and the watery fluids, all obeying the great law of attraction.

One of the most remarkable analogies between animals and vegetables is the production of oil. Vegetable oils need no example. Animal fat is no other than oil concentered by an acid peculiar to itself ; and which accordingly has been named the *Sebacic*. This acid, in proportion as it predominates, renders the oil more concrete. Suet, for example, is thus rendered more firm than the interposed fat of meats.

Vegetable mucilage has a considerable analogy to animal jelly, and sugar is a constituent of milk.

Carbonic acid is active in the animal economy, is active in the vegetable economy, and mineralizes half the substance of the solid globe.

Animals receive nutriment and increase of bulk through absorbed fluids derived from the fermentation of animal, vegetable, and mineral substances. Vegetables receive nutriment and increase of bulk through absorbed fluids derived

from mineral substances, vegetable mould, and decomposed animal matter; while minerals are only increased by the accession of new matter, cemented by cohesive attraction, capable of being separated by decomposing agents, and of reuniting by new modifications of attraction: and while one class of natural objects passes into another by shades more gradual than day into night, the whole chain of creation exhibits to the inquiring mind a perpetual revolution of the sublimest harmony, promoting an elevation of thought far beyond worldly inanity.

“The human body,” says the excellent bishop Horne, “was not made of the celestial elements, light and air; but of the more gross terrestrial matter, as being designed to receive and communicate notices of terrestrial objects by organs of a nature similar to them. In this instance, as in another since, God seemeth to have chosen the base things of the world to confound things honourable and mighty, when of the dust of the ground he composed a frame superior in rank and dignity to the heavens and all their hosts.

They whose profession leads them to examine the structure of this astonishing piece of mechanism, these men see the works of the Lord and his wonders in the formation of the human body. A contemplation of its parts, and their disposition, brought Galen upon his knees, in adoration of the wisdom with which the whole is contrived; and incited him to challenge any one upon an hundred years study, to tell how any the least fibre or particle could have been more commodiously placed either for use or beauty."

CHAPTER VI.

OF THE GENERAL STRUCTURE OF THE STOMACH, AND ITS MECHANICAL ACTION.

THE pharynx and esophagus have been described as a muscular funnel and tube, the latter descending in a direction nearly perpendicular, as far as the sixteenth joint of the spine. After passing through the diaphragm, its fibres are expanded around the upper opening of the stomach, which is technically called the Cardia, or cardiac orifice, from its vicinity to the heart, or *καρδία* of the Greeks. In short, the esophagus may be said to spread itself into a sac, shaped like the pouch of a bag-pipe (for such literally is the form of the stomach), lying in an oblique direction; its great curvature being to the left, which is the side where the esophagus descends, its descending point to the right, and resting beneath the left part of the liver. The word Stomach seems to have been compounded from *στομα*, a mouth, and *χίω*, to

pour, as the mouth or receptacle into which food is poured.

The stomach itself inclining forwards, its upper orifice or cardia forms an angle with the esophagus backwards, which, with the assistance of its muscular fibres, serves to prevent the return of food after it has been received into the stomach, and accounts for the difficulty commonly experienced in vomiting. The lower or descending orifice of the stomach has been named *pylorus*, or the pyloric orifice; because, like *πυλῶρος*, a gate-keeper, it detains undigested matters of aliment until they are properly prepared for passing into the intestines, by the contraction of a muscular ring, with which it is furnished, and which it relaxes when necessary.

The substance constructing the stomach is divisible into four layers: the outermost of which is derived from a membrane common to the whole interior of the abdomen, and which has already been adverted to, under its appellation of peritoneum, when speaking of the diaphragm, and which, being furnished with but few nerves and vessels,

is not commonly the seat of acute pain or inflammatory action. There is a cellular tissue between this and the second coat, merely as a medium of connexion, which, by way of refinement, some anatomists have distinguished as a separate integument.

The second is the muscular coat, consisting of two planes of fibres, the external of which observe, for the most part, a longitudinal direction, though some are oblique. They are chiefly concerned in propelling the contents of the stomach forwards. The inner plane consists of transverse fibres, which, individually, do not encircle the stomach, but form segments of circles in a corresponding direction, many of their tendinous filaments being observable. This particular arrangement of the muscular fibres furnishes an infinitely greater power of contraction than would be constituted by a series of entire circles: for while the longitudinal fibres of the stomach do not appear to contract in a greater proportion than those of the muscles in general, these segments of circular fibres are capable of extending themselves collectively

to a circumference of twelve inches and upwards, when the stomach is in a state of dilatation ; and have the power of contracting to a circumference of little more than an inch after long continued fasting. Although hunger is strictly an affection of the nervous system, it is to the contraction of these muscular fibres, whether partially or generally, that the uneasy sensations attending it may be referred. They frequently receive an unequal and capricious stimulus from flatulence.

The third coat of the stomach, which has been termed the nervous, is a layer of cellular tissue, giving firmness to its substance, and support to the vessels of its inner surface.

The fourth, or internal coat, appears an expansion of the inner membrane of the esophagus : but, having far more of a velvet-like character, it has been termed the *villous* coat. Through the openings of this, the inner surface of the stomach is furnished, from innumerable minute vessels, with that secretion peculiar to itself, which has been named Gastric juice. The villous membrane has also numerous undulating plaits or folds

transversely, which accommodate themselves to the different degrees of contraction exercised by the muscular fibres, and consequently to the increase or decrease of the capacity of the stomach, in proportion to the bulk of its contents.

By the contraction of its muscular fibres, and the corrugation of its internal membrane, aliment is retained duly in the stomach for the process of digestion. In this office the two orifices of the stomach are brought nearer to each other, the lower being considerably raised ; and if the necessary degree of relaxation at the pylorus be not effected within a seasonable period, the subjects of bad digestion are sometimes afflicted with the very troublesome consequence of ejecting a part of their dinners every day.

It is the villous coat of the stomach, in particular, by reason of its high vascularity, which so readily becomes inflamed on the accession of poisons, and especially those of a mineral nature : and death often takes place before they have passed beyond the stomach.

CHAPTER VII.

OF THE INTESTINAL CANAL—ITS STRUCTURE ACTION — AND GENERAL DISTINCTIONS — THE MESENTERY—THE OMENTUM.

THE intestines, like the stomach, have four coats, which are distinguished by similar appellations, because they are of a similar nature. The outer integument, or that formed by the peritoneum, completely invests the greater part of the intestinal canal; but in some instances it is only partial. Besides lining the inner surface of the abdomen, and investing the contained organs, it is the chief medium of supporting the whole in their proper situations, and more particularly the intestines, the entire tract of which, with slight exceptions, it may be said to inclose and suspend; the overlapping portions forming a firm duplication, which constitutes the mesentery; and this adheres steadily to the lower part of the spine.

The mesentery is so named from its situation

amidst the intestines (*μεσος*, *the middle*, *εντρερον*, *an intestine*). This duplicature of the peritoneum is rendered considerably thick by the interposition of cellulous and adipous matter, for imbedding a vast number of important vessels, nerves, and glands, hereafter to be noticed.

The elastic quality of the peritoneum in general evinces itself in enlargements of the abdomen and its contained organs, whether they be of a diseased kind, as in dropsy, or of a natural kind, as in pregnancy, and casual distension of the stomach and intestines; and it is abundantly supplied with vessels, which secrete a lubricating fluid to obviate the effects of friction.

There is yet another character or production of the peritoneum to be noticed, which is distinguished as the omentum, and is constituted by a double thin and delicate membrane, derived, with the exception of a small intestinal portion, from the outer integument of the front and back surfaces of the stomach, whence it hangs after the manner of an apron over the intestines and other alimentary organs. Between this delicate

double membrane, a quantity of fat is distributed much after the figure of certain corallines, the office of the omentum being altogether that of lubrication to the inner surface of the abdomen, and such surfaces of its contained organs as would otherwise come in contact with it, and occasion irritation.

The omentum seems to have been so named because its appearances constituted an especial omen for the judgment of soothsayers. This membrane has also been called *epiploon* (επιπλω), on account of its floating character, and *gangamon* (γαγγαμη) and *reticulum*, because it descends like a fishing net from the stomach over the intestines.

The intestinal canal forms an infinite number of windings and convolutions throughout its course, measuring upon the average six times the length of the individual, but sometimes considerably more. Its common distinctions are into large and small intestines, according to their diameter; the motions of the whole are effected by an arrangement of muscular fibres longitudinally and trans-

versely, like those of the stomach, the transverse fibres being also segments of circles only, which in the aggregate must obviously exert a greater force throughout the tract, than continued circles of similar structure. The alternate contractions and relaxations of these fibres constitute what is technically called the peristaltic motion of the intestines. The term undulatory perhaps would be more appropriate, since *περιστελλω*, the etymology of the word, means only to contract.

The inner surface of the small intestines is formed into numerous folds transversely, which, from their filling the office of valves in restricting the too rapid passage of aliment, have been called *valvulae conniventes*, and which, in plain English, I prefer calling the constricting valves. They form portions of circles only.

The inner surface of all the intestines receives an abundant supply of mucus from the ducts of numerous glands with which the tract is furnished throughout.

In the great intestines, the constricting valves are deeper than those of the small, and the inner

coat less velvet-like; while the glands which furnish their mucus are individually larger:

Although the intestinal canal forms an uninterrupted tract throughout, there are, notwithstanding, certain variations of structure in its general distinctions of great and small intestines, which have assigned particular characters to three subdivisions of each. Accordingly, these subdivisions are regarded as distinct intestines, the smaller being called *duodenum*, *jejunum*, and *ileum*: and the larger, *cæcum*, *colon*, and *rectum*.

The *duodenum* has been so named, rather in an arbitrary way, because its measure is something about twelve inches. Its great marks of distinction, however, are, that it is straighter than any other part of the small intestines, that it proceeds immediately from the stomach, and has therefore been regarded as a second stomach, because it detains the food which has passed the true stomach, until it be mixed with bile and a new salivary fluid, the ducts for supplying which terminate in its back part: and further, that it exhibits the first traces of vessels expressly adapted to

nutritive offices, besides mucous glands. This intestine completes the digestion of aliment, and is often the seat of many affections, which are attributed to the stomach itself, particularly such as result from inspissated bile, which has been unduly retained.

The *jejunum* is the next of the small intestines, and has been so named because it is commonly found empty (*jejunus*), from its more rapid powers of absorption. Its emptiness has also assigned to it the term *nestis* (*is not, so as to eat*). The convolutions of this intestine and the next are so numerous, as to render any attempt at describing them perfectly futile. It is of smaller diameter than the duodenum, but has less muscular power; the constricting valves of its inner surface are very numerous, and it possesses a great number of lacteal vessels.

The *ileum* constitutes the third and last of the small intestines, and is so named from its multiplied convolutions (*ileo, to twist or turn about*). The plaits of its internal surface are far less considerable than those of the jejunum, and towards

its termination they disappear altogether. It is every where smaller, thinner in its substance, and of a paler colour.

A spasmodic affection of the small intestines, commonly, though not essentially, from inflammation, has been termed *iliac passion*, because the *ileum* seems more particularly to be concerned in the disease ; and its contents are ejected by vomiting. The spasmodic action of this intestine gives rise also to an alarming accident, which is technically called *intus-susception*, or *intro-susception*, being a partial contraction of its diameter, so as to occasion one portion of it to be drawn within another, just after the manner that a part of the finger of a glove is sometimes accidentally drawn within another. It most commonly happens that this spasmodic action of the intestine draws the contracted part within the portion below it, although it sometimes happens, and more particularly in children, that the contraction is within the portion above it : and the impossibility of ascertaining which of the two is really the case before death, is to be regretted, since it would obviously

be preferable to use injections from the extremity of the intestinal canal with a view to relieve the contraction downwards, while purgatives from the stomach would promise the best chance of relief to that contracted upwards.

The undulatory and convolving motions of the small intestines are far more considerable than those of the great. While not disordered, they act like the waves of a flowing tide, which, although its direct course appears doubtful because they move forward and backward, still directs itself onwards. By this kind of action, the intestines, and more particularly the small ones, separate nutritious from offensive matter, after which process, the mechanical weight of the excrement, with the assistance of bile and partial distention from disengaged vapour, stimulates the muscular fibres to contract, and propel it to the end of the canal. When their office becomes interrupted, the intestines take on the action of an agitated sea, the oscillations of whose waters between the opposing breakers express the utmost perplexity to advance onwards.

The evolution of air from their contents seems to influence the muscular action of the intestines as much as the stimulus of biliary and feculent matter. The separation of chyle from excrementitious substance, is a process of chemical decomposition, in the course of which gaseous bodies are formed, according to the affinities which are furnished by the contents of the alimentary canal at large. A degree of putrefactive fermentation attends the production of excrements, and putrefactive fermentation cannot take place without the evolution of air. The evolution of aëriform matter takes place as soon as aliment is acted upon in the stomach, and may be regarded as essential to the sufficient distention of the entire canal.

The three great intestines exceed the others infinitely in diameter, although their length is comparatively inconsiderable. They are also less convolute, their outer surfaces more irregular, their inner more completely formed into cells, and furnished with many adipous appendages.

The *cæcum*, which is the first of the large intestines, forms a sort of bag beneath the termina-

tion of the ileum, its length being scarcely more than equal to its diameter, which is rather more than double that of the ileum. It rests upon the inner surface of the right hip bone. The bottom of this sac-like intestine being turned downwards as if closed; has occasioned the term *cæcum* to be applied to it; from the Latin *cæcus*, blind or secret. It is also remarkable for an appendage about its own length, which proceeds from the left of its back surface, in figure and diameter resembling a common earth worm. This vermiform appendix is convoluted, adhering by the sides; one extremity opening into the back part of the intestine, the other being closed. Its office is not perfectly understood; but I am inclined to believe it an accommodation, either to furnish mucus when the ordinary supply is deficient, or to retain such as is redundant. It is constructed like the intestines in general, and has numerous glands.

The *colon*, so named from the Greek *κοιλον* *hollow*, constitutes the principal part of the tract of large intestines. It is particularly distinguished

by three ligamentous bands on its outer surface, which run longitudinally, and form three parallel divisions. Its junction with the cæcum is distinguished as its closed mouth, because the bottom of that intestine forms with it a sort of shut sac. The colon is, in fact, no other than a continuation of the cæcum, over the surface of which the ligamentous bands are also apparent, though less substantial. From the right side, just within the hip, the colon proceeds upwards, so as to form across the abdomen what is distinguished as its great arch ; and after this, two convolutions on the left side, which, from a resemblance to the Greek Σ , are distinguished as its sigmoid flexure : and in this manner the intestine terminates about the last joint of the spinal column, being supported throughout its course by duplicatures of the peritoneal membrane.

The colon, from its circular course, is contiguous to all the digestive organs. It receives a valve within, chiefly from the substance of the ileum, which perforates it at a short distance from its extremity, and which Winslow calls the sphincter

or pylorus of the ileum. This valve closes when the colon is distended, thereby preventing its contents from returning to the small intestines. Under the influence of disease, however, its contents are sometimes driven back by retrograde muscular action, so as to be ejected by vomiting. The longitudinal muscular fibres of the colon are collected into three principal fasciculi throughout its course, contracting the inner surface into a three-fold series of cells, considerably deep, and much influenced as to their general capacity by the existing degree of distention. The natural office of these cells is to promote a gradual descent of the excrement into the last intestine; but when the action of the canal is torpid, they are productive of serious evil by detaining it unduly. It is in this intestine that the formation of excrement is completed.

While acute pain without any sense of weight characterises affections of the small intestines, a great sense of weight with less violent pain characterises those of the great intestines.

The *rectum* is the last member of the intestinal

tract, and so named from its straight direction to the final orifice of the canal. Its origin is derived from the last convolution of the colon, which is expressly adapted by a curvature backward, and then forward, to obviate the inconvenience of a rapid transition of its contents into this intestine. The rectum is more muscular than any other part of the intestinal canal, the longitudinal fibres investing every part of it, while the circular are more powerful. The peritoneal integument is only partial, and there are no ligamentous bands like those of the colon. Although much wider, it contracts towards its extremity into longitudinal folds, which form a narrow orifice capable of great dilatation on the stimulus of the propelled contents, and contracting immediately after. Between the longitudinal folds there are numerous veins, which by mere mechanical pressure from detained excrement, inflammatory irritation from cold, and various other causes, protrude and obstruct the passage, frequently becoming of considerable bulk if neglected, and thus constituting the disease known under the name of Hæmorrhoids or Piles.

It is a very common opinion that this malady is the necessary result of luxurious and intemperate habits of life, or a full and gross habit of body. The most temperate and abstemious livers however are almost as frequently afflicted with it: and in such it may be induced by general debility, by studious and sedentary occupations, and by sitting upon a damp seat of any description whatever. Few disorders, therefore, require more varied or more discriminate treatment, according to the circumstances of constitution and of cause. The lower folds of the rectum are the especial seat of those small worms known under the name of *Ascarides*; and with which children are so commonly tormented.

The inner surface of the rectum is corrugated in a transverse direction by muscular contraction only, since there are no constricting valves naturally furnished to it. Besides being more muscular, it is also more supplied with mucous glands than either of the other intestines. It is accordingly subjected to cancerous and other affections

of the glands, which are contiguous to the more substantial muscles. Cancer seems generally to originate in those glandular bodies which are near muscles. The arteries which supply glands are their final branches, and the disease occurs mostly either at a time of life when the circulation is naturally languid, or in subjects where it has been rendered so by disease, by errors in aliment, or by habit of body. Whatever may have caused a morbid circulation locally, seems to meet increase of disadvantage by the contractile powers of the muscular fibres, whereby the natural process of glandular secretion is partially interrupted, and disease supervenes accordingly.

By reason of its highly muscular construction, the rectum sometimes suffers from a relaxation of its entire substance, a considerable part of which, being forced without the common orifice, becomes constricted by the surrounding muscles, and is frequently returned with great difficulty. The patient is subjected to frequent returns of the malady, unless it has been occasioned by general

habits of life, which it is in his power to avoid : and persons so afflicted cannot too carefully abstain from strong efforts to evacuate the passage.

Besides its own muscular apparatus, the rectum is assisted both in the expulsion of its contents, and the subsequent constriction of the opening, by a circular muscle of the body intimately incorporated with its own fibres, named the *sphincter* (from *σφιγγω* to close), and by two small longitudinal muscles at the sides of the sphincter.

CHAPTER VIII.

OF THE LIVER—ITS STRUCTURE AND OFFICES —GENERAL IDEAS OF THE CIRCULATING VOLUME OF BLOOD, AND ITS SECRETIONS.

THE substance of the liver is constituted by an assemblage of different kinds of vessels closely intermixed, their extreme branches forming innumerable minute conglobate bodies, in which the vascular character eludes the unassisted sight. This structure of the liver, like that of all other glands, is adapted to the process of secernment or secretion, which is no other than the separation of a peculiar and more refined fluid from the common mass of circulating blood; the general structure of glands being more or less dense and firm, according to the chemical qualities, specific gravities, and common consistence of the particular fluids they are destined to secrete.

It is evident that all arteries diminish gradually in size as they approach their terminal points, in

the same manner as the branches of trees diminish as they retire from the main trunk. Secreting bodies or secreting surfaces are among the most frequent objects to which the ultimate ramifications of arteries are directed, and from whence various new modifications of vascular apparatus are transmitted for the distribution or supply of particular fluids to various parts of the animal economy. Perhaps all those vessels may be regarded as no other than different kinds of arteries; for many of the most conspicuous arteries may be traced into branches so minute as to demonstrate that their contained fluids gradually lose the character of blood: they finally become white, are no longer to be traced, and seem to assume a new character. Still it is sufficiently to be ascertained, not only that blood is the common mass from which every other fluid of the animal system is separated, but from which solid earth is also separated for the induration of the bones in their progressive growth, and for repairing their injuries by fracture and other causes. This latter office is abundantly demonstrated by forcing

coloured injections into the arteries of growing bones, where the lime is seen to issue from their orifices in the form of a pure white powder, and deposit itself, like the farina of a flower, for the office of consolidation. In a similar way, the injected arteries of the common domestic hen, while her eggs are incomplete, will show the deposition of lime from their exhalent branches upon the membrane which afterwards becomes the shell, the vascularity of the membrane gradually disappearing upon each egg in its progress towards completion; the surface being earthy and uneven, until the necessary portion of lime is furnished, but becoming smooth and even when the earth, by cohesive attraction, is duly crystallized, and the egg rendered fit for extrusion. That attentive observer of nature, the late Mr. Sowerby, kept some hens in a place where they had not access to any sort of dry earthy matter; their food being such as is commonly given to poultry. The shells of the eggs they produced were either earthy and deficient of firmness, or little more than membranes. Lime, rubbish, broken egg-shells, and other cal-

careous matters were now supplied, to which the birds greedily resorted; and afterwards produced perfect eggs. Those extreme branches of arteries which terminate by open mouths, either upon internal cavities, or upon external surfaces, are commonly denominated exhalents.

The gradual diminution of the diameter and the multiplied ramifications of the extreme points of arteries, seem an accommodation for separating or straining fluids of a more refined nature from the common mass of circulating blood; while the vessels destined to convey new fluids, beginning with arrangements similar to the termination of arteries, unite into main ducts for conveying the particular secretion to its destiny, as bile from the liver to the intestines, and various other fluids from one part of the system to another. It is this process of separation by glandular bodies which furnishes mucus, fat, and every other medium for defending the irritable surfaces and complicated machinery of the body at large. Chemical affinities explain nothing of the process, although it be chemical; since the mysterious principle of life,

which is a veil too sacred for human penetration, screens the nature of it from inquiry.

The general figure of the liver adapts itself, by a convex upper surface, to the vaulted expansion of the diaphragm, from whence it is suspended obliquely by a broad ligament, the support of which is increased by a round ligament proceeding from the common lining of the abdomen, and which is the condensed substance of a vein, by which, with other vessels, the foetus is attached to the mother through the medium of the placenta, or what is commonly called the after-birth.

The broad suspensory ligament of the liver marks two principal divisions of its substance, distinguished as the right and left lobes. The right lobe is by far the largest, and situated within the lower ribs of the right side. Its posterior part is thick, gradually diminishing forwards, so as to form an acute margin. The left lobe is comparatively small, thinner in substance, and situate above the declining part of the stomach. The upper surface of each lobe is furnished with a ligament for its more firm attachment with the

diaphragm, that of the left being longest, on account of the general obliquity of the liver. A fifth ligament, spreading along the back part, and called the coronary, increases its connexion with the diaphragm; all five being modifications of the peritoneum, and which membrane, in a more delicate form, invests the whole organ.

The under surface of the liver is concave, and adapted to rest upon a part of the stomach and intestines. A secondary lobe, conspicuous on the under surface of the right lobe backwards, has been named the *lobule of Spigelius*, from its describer. This eminence is shaped like a culinary ham, lying obliquely with the bone end forwards, a little to the side of which an arch-like fissure is formed called *porta*. The main division of the two lobes is marked beneath by a fissure in the same direction as that of the broad ligament above, and terminating in a notch, whence the round ligament proceeds to the upper surface.

The principal trunks of the blood-vessels, absorbents, and nerves of the liver, together with its biliary ducts, are included in a common mem-

branous sheath, distinguished as the *capsule of Glisson*, in compliment to its describer.

A principal blood-vessel of the liver, named *vena portæ* from its passing under the porta, and formed by the union of branches from the veins of the stomach, the intestines, the omentum, the spleen, and the pancreas, is remarkable for filling the office of an artery and a vein. While it resembles an artery in the thickness of its coats, and in the office of propelling blood from its trunk to the branches, which accompany those of the especial artery of the liver, it has no pulsation; in which circumstance, as well as that of conveying blood to the heart from converging branches, it resembles a vein. The common veins of the liver, which are very numerous, and derived not only from the extreme branches of its main artery, but from those of the *vena portæ*, unite into two or three principal trunks, which join the great vein of the heart, and thus transmit their blood to it; all the veins of the animal body being originally constituted by the union of minute branches, which become gradually larger and less multiplied

as they approach the heart, their ultimate branches having been reflected from the extreme ramifications of arteries, which on the contrary gradually become of less diameter, and more multiplied throughout the system, as they are remote from the heart.

The heart may be regarded as a powerful muscular bulb, sending off a single trunk ; from which branches proceed, by division and subdivision, to the remotest parts of the body ; and such are the arteries. The primordial veins may be regarded as so many radicles, which contribute to the formation of considerable roots, and these roots tend to one chief source for returning blood to the bulb. A retrograde movement of the blood in its ascent through the veins is prevented by valves, with which they are furnished by their internal membranes, wherever necessary.

Where the extreme branches of arteries connect themselves with the primordial branches of veins, a bulging is observable, somewhat like the condensing receiver of a chemical apparatus, as if it were the part in which the blood takes on its

new character; or its office may be supposed to be analogous to that of the vegetable capsule, in which the process of fecundation is completed. This capsule-like termination of the arteries is particularly observable with a magnifying power in those of the liver.

The blood having thus undergone circulation through the general system, meets an apparatus on its return to the heart, for propelling it, in a similar manner, through the substance of the lungs, by the continuation of which process it is maintained suitable to the service of life; and passes as before into the common arterial trunk.

The secretion of bile having been completed in the substance of the liver, it is received into numerous minute tubes, which, gradually uniting into larger, form two principal branches, and these lastly, unite into one distinguished as the *hepatic duct*.

The hepatic duct passes within the fissure of the under surface of the liver, and soon joins the cystic duct, which is a smaller tube sent from the neck of the gall-bladder. The tube formed by the

union of both these, constitutes the common bile duct, which is scarcely the diameter of a pen, and which, insinuating itself for some way obliquely between the muscular and inner coats of the duodenum, terminates in the back of its internal surface, where, in describing that intestine, the bile was stated to enter. Thus it will be seen that the presence of bile in the stomach itself is the result of diseased action, since none is naturally supplied to it; and the arrangement of the duodenum with respect to the stomach, is calculated to prevent any return of its contents into that organ. The presence of bile in the stomach induces sickness, faintness, shiverings, and cold sweats.

The gall-bladder is a small pear-shaped bag, of oblong figure, closely affixed by cellular tissue and vessels, to the under side of the right lobe of the liver near the great fissure; and placed obliquely with its bottom forwards. Its general structure is much the same as that of the intestines, though few muscular fibres are observable: and even those under some effects of disease, are not to be traced, whence it has been questioned

whether the gall-bladder has any muscular fibres of its own ; but muscular fibres are essential to the corrugation of its inner surface, which serves to regulate its capacity : and I am very confident that many effects of disease which I have observed where the fibres have disappeared, must have resulted from a muscular power of its own. Besides this, while the stomach and intestines are empty, the bile appears naturally to remain quiescent in the gall-bladder, which does not discharge it until the stimulus of food excites the surrounding organs, and these, particularly the stomach, communicate a stimulus to its own contractile apparatus. Bile differs in its natural degree of viscosity, of bitterness, and of colour, in different subjects, holding in solution saccharine, resinous and albuminous matter, together with soda. It appears to modify and correct the acidity of the alimentary mass.

CHAPTER IX.

CONCERNING MORBID AFFECTIONS OF THE LIVER, AND DISORDERED STATES OF THE BILE.

THE gall-bladder is evidently something more than a mere mechanical reservoir for collecting the bile after it has been formed in the substance of the liver, and appears to effect certain alterations, more fully to prepare it for its further office, in the same manner as the stomach prepares its alimentary contents for transmission through the intestines. The bile, whilst it remains in the gall-bladder, becomes far more viscid, more resinous, of a darker colour, and more powerfully stimulant. It appears the chief medium for separating the excrementitious from the nutritious contents of the intestinal canal, and by intermixing with the excretory matter, to prevent the mischievous effects of that putrefaction, which, naturally resulting from the fermentation of the alimentary mass, would otherwise prove hurtful.

It may be regarded not only as the natural purgative, but the natural antiseptic of the intestinal tract. The degree of colour it imparts to the excretions, is a valid criterion of its qualities and influence. When they are pale, it is inefficient ; when green, it has an excess of acid ; when blackened, it is grossly vitiated. Healthful bile duly supplied, mixes intimately with the egested mass, imparting to it a deep yellowed brown ; and whatever dark coloured matter may have been communicated to it by fruits, by metallic medicines, or other causes, still this yellowed brown is observable, if the supply of bile be healthful and efficient. When bilious matter passes through the intestinal canal in undue quantity, and without proper assimilation with the excretions, it is of a bright yellow colour, which colour however is deeper than that of the bile in the substance of the liver, previous to its deposition in the gall-bladder.

In the gall-bladder, and in the gall-ducts, are seated the causes of many morbid affections of the liver, more frequently than in its actual substance. Inspissated bile in either is often the

occasion of disease, and inspissated bile long retained favours the formation of gall-stones; these clearly begin with an accretion of the resinous particles of the bile, which on fracture may be seen to radiate in a crystalline manner through their substance. The apparent coating of a gall-stone is sometimes no other than a superficial decomposition from the influence of the more fluid part of the bile, promoted by attrition after they have attained their full size. Frequently however they are considerably laminated, their general characters being influenced by the species of morbid action, and by constitutional circumstances on the part of the patient.

Where a single gall-stone exists, it is generally more ovate or globular than where there are several; for it sometimes happens that the gall-bladder is so crowded and so distended with them, that the opportunity for attrition is very limited.

Gall-stones are also formed in the substance of the liver, whence they are forwarded to the ducts, where in many instances they lodge so as to occasion mechanical obstruction, in the same

manner as those formed in the gall-bladder itself. Sometimes they descend into the bladder, and if not propelled from thence into the intestines, they gain very considerable accretions. In either instance, the mischievous effects are the same; the natural functions not only of the liver, but of the stomach and all the digestive organs, being totally deranged.

In jaundice, the gall-ducts are obstructed either by concretions, or by morbid viscosity of the bile; in which case it is prevented from passing into the alimentary canal, and being taken up by the absorbents is carried into the blood. The excretions are therefore colourless, while the eyes and the whole skin are tinged with yellow.

The causes of obstruction to the ducts, besides those alluded to, may be spasmodic affections resulting from local disease at a distance from the liver, violent fits of passion, long continued despondency, obstinate flatulence, either from partial spasmodic contractions of the intestines, or by a neglect of due evacuations, where nature has been torpid or irregular. Pregnancy is some-

times a cause of jaundice, but this affection yields readily after delivery. The worst form of the disease is that which results from induration of the substance of the liver; and this, in advanced life, may be occasioned by bruises from falls, and other accidents.

In hot climates, the circulation is rendered languid, and the liver suffers from various causes of fever. Where the heart has not the power to propel the blood with due force, the irritability of the arterial branches of the liver is destroyed, and frequently its substance becomes indurated without any aggravation from intemperance. But far more commonly induration of the liver (technically called scirrhus or scirrhus) results from inordinate drinking, inordinate eating, and indolent habits, in all countries. The effects of hard drinking upon the liver are proverbial; but the effects of gluttony and even of luxurious varieties of food, together with indolence and inactivity, are not sufficiently insisted on in a general way, as influencing its diseases.

Intemperance always has an argument ready to

adduce in its own defence: and, although rarely, it sometimes happens, that vices of this kind do not appear to act so specifically upon the liver as is commonly imagined ; for I have now and then found the livers of determined drinkers, and gross feeders, in no degree indurated, enlarged, or otherwise disordered, whilst the cause of death has appeared in some other internal organ. Fashion, however, will have its day in the desert of sickness, as well as in the fields of pleasure ; and it has been very fashionable of late years, as every one knows, to talk of “ liver complaints.”

The symptoms of liver diseases during life are sometimes fallacious ; for besides the other organs more immediately connected with it, the lungs have been found to be the cause of death where the liver was supposed to be so.

In addition to its usual symptoms, inflammation of the liver is very commonly accompanied by inflammation of the lungs, or of the membrane lining the chest, and furnishing their common covering. Difficulty of breathing is experienced

with a sympathetic cough, most frequently dry, but sometimes accompanied by a great expectoration of vitiated mucus from the stomach ; which confirms the idea that the lungs are the primary seat of the disease, while the lungs in reality are not sufficiently affected to be the cause of any disease to themselves.

On the contrary, in some instances of decided pulmonary consumption, and more particularly in advanced life, certain attendant symptoms of a disordered liver evince themselves, which have established the opinion that the liver was the primordial seat of disease, while it was by no means disordered ; and medical practice has accordingly directed its efforts without success.

A physician of considerable popularity, who found his dissolution approaching from what he declared himself certain was the influence of a diseased liver, requested that the organ might be particularly examined after death, for the purpose of assisting the views of his professional survivors in similar cases ; since he thought it extraordinary that mercury should have afforded him no benefit,

when it had been the means of relieving so many of his patients. He died very shortly after ; and when his remains were examined, the liver was found of its natural size, of healthful appearance generally, and without the slightest trace of disease on any part of it ; nor were the adjoining organs by any means disordered ; but on examining the lungs, they exhibited an entire mass of disease.

An eminent military surgeon of the most temperate habits, and of the mildest possible disposition, who from the time of our late campaigns in Egypt, had never ceased to suffer severely from irregular action and agonizing pains of the alimentary canal, and organs connected with it, died about twelve months since. The abdominal cavity was carefully examined by a first-rate anatomist ; when the whole of its contained organs appeared so little disordered as to account, in no material degree, for his alleged maladies, and much less for his death. Of the lungs, however, but little substance remained ; and an entire quart of purulent fluid was found in the chest. It is

extraordinary that this amiable and excellent man, throughout his years of suffering, never complained of any pain in the chest; and that no cough or other symptom of faulty lungs presented itself until within three days of his dissolution.

Notwithstanding what has been said, it is undoubted, that the irritation of a diseased liver has extended its influence to the lungs so effectually, as to establish decided pulmonary consumption; and it has even been imagined that pulmonary consumption always originated in a disease of the liver: but this is an extravagant speculation, which is not supported by the evidence of anatomical investigation.

One of the most frequent effects of warm climates upon the liver is to occasion a redundant secretion of bile, so that the fluid cannot effect its natural course into the intestinal canal, but finds its way largely into the blood; and becoming separated from the general volume, transudes, as upon the occasions before stated, through the exhalent vessels, colouring the skin, the perspiration, and the urine; while the excrement, for

want of the natural admixture of bile thus thrown out of its course, is of a pale colour, and forwarded with languor. The stomach is nauseated, the appetite fails, the powers of digestion are enfeebled, and continual listlessness prevails.

That disordered state of the bile, which causes it to be ejected both by vomit and intestinal discharge, constituting with the attendant spasms and other symptoms, what is now known to every one as *cholera morbus*, or the bilious disease (*χολη bile, ρέω to flow*), is most commonly the result of errors in diet, through which the stomach and intestines are principally affected by the presence of acrimonious matters. The disorder also results from violent fits of passion; and by this cause it is sometimes unfortunately communicated by a nurse to an infant at the breast. In hot climates, the atmosphere is often the cause, as it is also in the unusually hot summer of a temperate climate, being more frequently fatal in the former than the latter, where with active measures it is soon subdued.

CHAPTER X.

OF THE SPLEEN AND ITS APPARENT OFFICE:

THE SPLEEN is an oblong, oval body, of a livid purple colour, soft in its substance, exceedingly vascular, and situate between the stomach and lower ribs of the left side, much influenced as to its obliquity of inclination by the motions of respiration, and by the distention or emptiness of the stomach. Its convex surface, which has a longitudinal furrow, is opposed to the diaphragm, its concave surface towards the spine; the common membrane of the abdominal cavity maintaining it in its proper situation. While the blood-vessels of the spleen are larger in proportion than those of any other internal organ of the body, it is unlike any other of a glandular nature, in having no excretory duct. From this circumstance, its office in the service of life is rendered obscure, and the investigations of two thousand

years have furnished no satisfactory elucidation of it.

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Notwithstanding these considerations, the opinion most generally accepted is, that the spleen effects a process in the blood, which prepares it for assisting the secretion of bile; and chiefly in consideration of its contributing very largely to the formation of that hybrid blood-vessel of the liver called the *vena portæ*. To my humble apprehension, the spleen appears altogether subservient to the liver, and a vast deal of mystery and perplexity seems to have been attached to its office, which is derogatory to the general simplicity of natural operations throughout the animal economy. May it not be an organ whose offices are called especially into action when the liver is so far diseased as to be incapable of fulfilling any of its natural functions?—I have more than once found the spleen in every respect healthy where the whole organization of the liver was diseased, and where the failure of its functions had been the occasion of protracted sufferings, and the palpable cause of death.

The idea of the spleen assisting the office of the liver, besides being the most frequent, is one of the most ancient, since Hippocrates calls it the left liver, and Aristotle the bastard liver.

The ancients, who dwelt much upon the influence of "*atra bilis*," or black bile, on various phenomena of life, and particularly on melancholy, regarded the spleen as the express organ for its secretion. It was to this especial object that the attention of Democritus was directed, when Hippocrates, in obedience to the affectionate solicitations of the senate and people of Abdera, visited the scene of his retirement for the purpose of satisfying them concerning his supposed madness, a vague error which the anatomical researches of that great philosopher had chiefly occasioned. Democritus declared to his learned and amiable visitor, in the course of their conference, that he believed bile to be the most common cause of madness. Hippocrates adopted the opinion, and for more than two thousand years it obtained very extensively. The effects of this secretion, when disordered, upon the animal spirits, no revolution of time has been able to invalidate.

The gloom and melancholy which so commonly become established in the inhabitants of hot climates, and in the confined residents of crowded cities, who are not intemperate, and have no mental causes for its derangement, may be referred to a faulty action of the biliary system, which is at all times readily brought on by such circumstances; and which is also a principal concomitant of that exhausting fever induced by the *mal aria* of Rome.

The term *milt*, by which the spleen is distinguished to this day among the vulgar, appears to be of Saxon origin, while the more general appellation is scarcely altered from the Latin *splen*.

CHAPTER XI.

OF THE PANCREAS, ITS STRUCTURE, AND OFFICE.

THE PANCREAS is a salivary gland of conglomerate structure, and of an oblong flattened figure, lying transversely between the back of the stomach and the spine. To the right it is elongated, and attached to the duodenum, into which intestine its chief duct enters obliquely with the common bile-duct of the liver. The pancreatic duct, which is about the size of a crow-quill, is constituted by the union of numerous small ducts from the substance of the gland, as in the salivary glands of the mouth. The saliva furnished by the mouth has only to assist the aliment in gradual portions as far as the stomach, where gastric juice is ready to incorporate with the accumulating mass. This, when sufficiently prepared, has to pass into the duodenum, where a new accession of salivary fluid appears to be required for aiding its further passage through the long and convoluted tract of

small intestines. Accordingly, the pancreas is larger than all the salivary glands of the mouth together. The bile, which also meets the alimentary mass in the duodenum, is not only a powerful stimulus for propelling it throughout the intestinal canal, but is equally antiputrescent.

The pancreas has most inaptly been so named, from *παρ* *all* and *κρέας* *flesh*, since nothing like flesh is concerned in its structure. In animals it is called the sweet-bread.

CHAPTER XII.

OF THE ABSORBENT SYSTEM, AND ITS GENERAL OFFICES.

MANY phenomena of the animal economy, whether its functions be healthful or diseased, demonstrate a removal of particular kinds of matter; either partially or generally, from certain of its internal or external parts; the matter so removed being carried into the blood by delicate pellucid tubes, which are distinguished as absorbents, or absorbent vessels, the general distribution of which remained very obscure until about the year 1654, when the investigations of Rudbeck and Dr. Jolyfe considerably elucidated the subject: Dr. Munro and Dr. Hunter, having afterwards directed their attention to it, were led to similar conclusions with respect to the general influence of the absorbent system, about the year 1757.

Notwithstanding the attentive investigation, however, which for centuries has been bestowed

upon the subject, we are obliged to reason from analogy concerning many phenomena of the absorbent system ; but still may confidently believe that its vessels are both active and numerous in many parts of the body, where, on account of their minuteness and delicacy of substance, they cannot be traced ; effects being observable where they are not seen, precisely similar to those of which they are clearly and evidently the cause : and, fortunately for the present object, those absorbents which are concerned in the office of conveying nutriment from the alimentary organs into the blood, whereby it is diffused throughout the body, are the most conspicuous of the whole series.

The vessels of the absorbent system are usually distinguished as *lacteals* and *lymphatics*, the fluid contained in the lacteals, as the term implies, having a milky appearance ; that of the lymphatics (*νυμφη* water) being pellucid and watery. These appearances alone are the cause of distinction : for the structure, office, and distribution of both kinds are similar, and both convey various

kinds of matter, whether fluid or earthy, in a state of combination, solution, or suspension. Both are furnished with valves, in the same way as the veins, to maintain the due course of their contents, and with blood-vessels and nerves for the support of their living powers.

Besides these, there are numerous gland-like bodies concerned in the office of absorption, which probably consist of convoluted vessels, and which are either stationed under the skin, or in the vicinity of considerable blood-vessels, particularly those of the mesentery, in the substance of which they are more considerable than in any part of the body. These glands, which are of a compressed globular or ovate figure, appear to be destined either for refining, or effecting some other chemical process in the absorbent fluids, to prepare them duly for the blood, in the same manner as the more conspicuous glands modify the various secretions from its common mass.

From those delicate processes of the inner surface of the intestines, which from their constituting an appearance like velvet have been named

villi, the lacteals take their origin. Each vessel is formed by several minute radiated branches from a single process, where their orifices are stationed for the purpose of attracting the nutritious fluid called chyle (*χυλος juice*), and which, from its milky character, has given name to the vessels of this system as was just now stated. The radiated tubes pass from the villi, under the muscular coat of the intestines, to form more considerable tubes, which follow the course of the blood-vessels towards the heart. They are more numerous and conspicuous in the jejunum than any other part of the alimentary canal; and it is from this circumstance, which promotes a rapid absorption, that the intestine is commonly found empty. The lacteal glands of the mesentery, which are commonly distinguished as the mesenteric glands, are more large and numerous in that part of it which is attached to the jejunum than any where else. These glands are imbedded, in the course of the principal lacteal vessels, in the fatty substance of the mesentery, and stationed near its blood-vessels.

The large intestines are furnished more sparingly with absorbent vessels than the small. Those of the cæcum join the branches of the small intestines ; but they altogether diminish in size and frequency towards the termination of the intestinal tract. Still they appear, upon some occasions, to contain chyle, where it has not been duly separated from the alimentary mass in the earlier part of its progress ; and their influence becomes evident under diseased action of various kinds. The stomach is only partially furnished with absorbents, the natural office of which does not appear to be that of conveying chyle. Absorbent vessels also proceed from the liver, the spleen, the pancreas, and the omentum, all tending to one common course into the general volume of blood.

Hippocrates, and other writers of ancient times, seem to have applied the term chyle in its general sense to vegetable infusions or decoctions, which had been strained for the purpose of freeing them from their impurities.

The exact nature of chyle, although it has been called the oily part of our aliment, is by no means

understood ; for it cannot be obtained of sufficient quantity, or in an uncombined state, for chemical analysis. It is, however, remarkable that it seems uniformly the same in all animals, from man to the lowest ; and to be influenced in no degree by the nature of food. An erroneous opinion has been adopted, that it considerably resembles milk in its general properties : but if this be the case, why does milk assimilate so badly in the greater number of instances with the natural fluids which it meets in the stomach ? and why is it not received into the absorbent system until its nutritive matter has been modified by digestion ? The experiment of injecting milk into the blood-vessels of living animals has been productive of effects which prove that nature has not ordained any such assimilation for the animal system. Chyle seems never to have been detected in the absorbents of the stomach, nor to have become duly characterised until the aliment has been submitted to the influence of bile, and other animal fluids in the duodenum.

Chyle, like blood, exhibits globules, and it pos-

sesses serum and coagulable matter. Under the influence of some diseases, however, it does not unite perfectly with the blood, and has been seen separated in a mass recently abstracted.

The lymphatics chiefly take their course from the extremities towards the centre of the body; their primordial tubes converging, and directing their branches to the same termination as the lacteals. Those of the legs and thighs, beginning from the feet, meet glands in the groin: those of the arms meet glands in the arm-pit.

Lymphatics are clearly defined on the face and outside of the head; but in the substance of the brain they are not to be traced, although they have been found to accompany the blood-vessels of its membranes, and appear, by the effects of disease, to be frequently active in producing it. They have moreover been found in the brains of fishes.

The irritability and extreme sensibility of the superficial lymphatics are evinced under the influence of any morbid acrimony of their contained fluids; for instance, such as may be communicated by a poisoned wound of the hand or finger,

when those of the arm in particular may be traced throughout its length, appearing thin, slender, and of a faint purplish red colour, being acutely painful. When once witnessed in this state, they cannot readily be mistaken for vessels of any other kind.

The lacteals, and nearly all the lymphatics, after converging from their respective origins in all parts of the body to form tubes, which gradually become more considerable, terminate in a single trunk, which is called the *thoracic duct*, from its situation within the chest, and which duct terminates in the great veins at the lower part of the neck, at the angle formed by those which are distinguished as the carotid and subclavian veins.

In this manner the chyle and lymph are carried by the veins to the heart, and diffused through the general mass of circulating blood. A few lymphatics very commonly terminate in the diverging veins at the bottom of the neck at some distance from the thoracic duct.

CHAPTER XIII.

SUMMARY OF THE DIGESTIVE PROCESS—SEPARATION OF NUTRIMENT FROM THE CRUDE MATERIAL—INFLUENCE OF THE LATTER ON CERTAIN AFFECTIONS OF THE BOWELS AND GENERAL SYSTEM.

DIGESTION may be defined the preparation of aliment for its conversion into blood. By the process of digestion, the specific differences of all objects of aliment disappear, and the chief of its products constituting chyle, are gelatine, sugar, and oil; but in many instances, the chyle, as already observed, contains substances of a different nature. Digestion has been regarded by some physiologists, as a process of simple solution; but it is evidently effected by the united agencies of several animal powers. By solution is understood literally the division of solid bodies into particles, which unite intimately with those of the fluid by which they are acted on; and the gastric juice alone has accordingly been regarded

as the solvent of aliment at large. But this opinion has not been advanced with sufficient caution; the assimilation of aliment being in reality effected not only by gastric juice, but the operation of heat, of saliva, and of mechanical trituration, by the muscular fibres of the stomach and surrounding parts.

Of the teeth in each jaw, the four central are simply adapted to cut or divide the food; the three on each side of them, to break down and gnaw it; and the remaining three on each side, to grind it as in a mill. In the course of this mechanical preparation it mixes with saliva from the glands, which have already been described; and, drawn by muscular contractions through the pharynx and œsophagus into the stomach, it receives a new combination of fluid peculiar to that organ, termed gastric juice, which exhales from the minute vessels of its inner surface. It is here subjected to a degree of fermentation, and forms a pulpy mass, which is technically called chyme, a term vague and indefinite, since chyme, like its etymology *χυμος*, means juice of any kind, and alimentary

pulp is something more than juice. In consideration of the several vital agents which are concerned in the digestion of food, I adopt the term, and the doctrine of assimilation, in preference to the bare idea of simple solution.

The food having remained in the stomach a sufficient length of time for mixing intimately with its juices, a stimulus is communicated to the pyloric orifice, which relaxes, and admits of its passage into the duodenum, contracting immediately afterwards. In the duodenum, two new fluids are ready to meet it, namely, saliva from the pancreas, and bile from the liver. The pancreatic saliva seems to complete the solution of the nutritious part of the pulp for transmission into the lacteal vessels; while the bile separates from the common mass whatever parts of it are unsuited to the office of nutrition, thus preventing the admixture of one with the other, in their course through the small intestines. The tract of intestines is every where furnished with a mucous fluid peculiar to itself, after the manner of the gastric juice of the stomach, which is di-

stinguished as "enteric juice," and which also assists the alimentary process.

The account which has been given of the absorbents, shows in what way nutritious matter is conveyed into the blood from the small intestines, and thus suited to the service of the whole system; while the office of the extreme arteries demonstrates in what manner different substances are separated, through their medium, from the common volume of circulating blood, and adapted to their respective uses. It therefore becomes unnecessary to insist any further upon the influence which the peculiar qualities of aliment are capable of exerting on the body at large; or by what means, when any one kind of matter prevails in the system, it is capable of affecting those particular substances for which it has the greatest chemical affinity.

Nutritious matter is more especially absorbed in the early part of the intestinal tract, because that particular part is most abundantly furnished with lacteals, which vessels diminish gradually towards the termination of the small intestines;

since in proportion as the excrementitious accumulation increases, the nutritious fluid becomes exhausted. Finally, very few absorbents exist in the large intestines; but those few are sufficient to exert a morbid influence by taking up offensive matter from the egested mass, either when it has been unduly retained, or when more than commonly disordered by the influence of disease, or by objectionable aliment.

The formation of excrement is not completed until its arrival in the colon, the cells of which are naturally adapted to prevent its descending too suddenly into the rectum: but these cells are the seat of very serious obstructions, either in torpid habits, or when the substance of the egested mass is unnaturally firm; and also when retained by spasmodic contractions or other causes. The muscles, which constitute a part of the external belly, not only assist materially in the office of breathing, but act powerfully in directing the contents of the alimentary canal out of the body, by exerting a general pressure; while the muscular

fibres of the tract itself are in action. Still, however, no muscular power is sufficient for extruding hardened accumulations, where they are considerable. By torpid action of the bowels, the excrement sometimes passes under numerous vermiform figures, which are exact casts of the cells of the intestines. Towards the end of the intestinal tract, hardened excrement also collects, in great masses, which frequently resist many efforts of medicine for their removal. Sometimes they lodge very partially in the cells, and are obstinate of removal, under globular figures, constituting what are technically called *scybalæ*.

I have already adverted to the oscillating motion of the alimentary pulp in the small intestines by their muscular action; to the evolution of air in its process of fermentation, as assisting the general distention of the canal; to the importance of the healthful condition of the bile, for determining the egress of the excrementitious mass; and to the chemical influence of food upon the bile and excrement.

Excrement is, in a greater or less degree, earthy, either in proportion as it has been separated under favourable circumstances, with respect to the general process of digestion; or as it has been retained, for a greater or less period, in the intestinal canal. Putrefactive fermentation produces an earthy residuum wherever it occurs; various matters, offensive to the animal economy, become absorbed from excrement which has been unduly retained; and as portions of matter so absorbed may be of an earthy nature, and that earthy nature considerably modified by the particular qualities of our aliment, it is evident that indiscriminate feeders, who permit considerable lapses of time to take place without a due evacuation of the bowels, and even those who promote but an imperfect action of them, by trifling and inefficient doses of aperient medicines, seem to favour the formation of calculous concretions by this medium.

I have commonly observed that children afflicted with urinary calculi, are such as have been fed indiscriminately. As long as children look

fat and florid, parents are too apt to imagine that their health is perfectly good. They are allowed to be perpetually eating whatever they are inclined for, their alvine evacuations are never observed, which most probably are of an unhealthy character; while their bellies are tense and prominent. Disease once established, advances with rapid strides; and such children are more readily brought down than those whose occasional sickness demanded attention to the state of their stomachs and bowels.

The entire tract through which the aliment travels has been shown to be abundantly supplied with mucus for facilitating the progress of its several objects, and for obviating any injuries which their particular nature may effect without such a defence. The mucus every where becomes vitiated, where the blood is vitiated; and blood is more frequently vitiated by unwholesome food, and the heterogeneous objects of luxurious tables, than by the casual accession of disease. If the blood be disordered, all its secretions must be disordered, as the bile, the saliva, the gastric

juice, the mucus; its excretions must also be disordered, as the perspiration, and the urine; both of which may be regarded as no other than the excrement of the blood. They are the media which nature provides for relieving the general system of impure and superfluous matter.

Under these considerations, no plan of medicinal treatment whatever can promise benefit, or can be instituted with prudence; before it is satisfactorily ascertained, that the alimentary tract is freed from all impurities throughout; and regular evacuations are promoted at proper intervals. Further, if, under a moderately good feeling of health, the state of the stomach and bowels be forgotten, disease insidiously creeps on, and at length evinces itself in a serious form.

The inconvenience of a dirty skin is felt, because its obstructed pores prevent the transmission of that insensible perspiration which is essential to health; and it is still more disgusting, because it is unsightly: but the languor, sickness, head-ach, and other inconveniences of filthy intestines can be endured, because they are un-

seen, though the healthful secretions of their internal surfaces throughout, are arrested precisely in the same manner, as the transudations of the skin from accreted filth on its surface ; for, on the inner surface of the intestinal tract, depositions of a disordered nature are made from the alimentary pulp when it is of an objectionable kind, in the same way as slimy depositions are attracted from a stream of water, by the floating weeds and pebbles over which it passes.

Under a morbid influence of the digestive process, the mucous secretions of the stomach are often so profuse, and at the same time discharged under such imposing circumstances, as to be mistaken for expectorations from diseased lungs. Disordered mucus is often long retained, by reason of its weight, in the lower part of the stomach, where it acquires additional thickness, the muscular action of the lower orifice not allowing of its transmission into the intestinal tract. It is therefore thrown up by violent efforts of coughing, under an alarming character, thick, heavy, and discoloured : the body is wasted, its vigour

declines, and the animal spirits fail; yet, however, the more alarming symptoms of night sweats and difficulty of lying on the side, do not occur; and it often happens, that by promoting due evacuations of the alimentary canal, by instituting a diet suitable to constitutional circumstances, and by change of air, the alarming symptoms disappear; the patient recovers his bodily strength and animal spirits, returns to his usual habits of life, and never after evinces any symptoms of disordered lungs. Still, when morbid secretions of the stomach have long provoked a cough, resisting all the efforts of medicine, it is but too evident, that by continued irritation, the chest does become affected, and pulmonary consumption decidedly established.

Despondency is both a cause and effect of morbid secretions of mucus in the stomach, and its discharge greatly relieves the animal spirits of the hypochondriac from time to time.

It is extraordinary upon some occasions, what copious and apparently spontaneous discharges of highly morbid matter are effected by the se-

creting surfaces of the intestines, after purgative medicines have been so repeatedly administered, as to convey a firm impression, by the characteristic appearances of the evacuations, that the alimentary canal had been effectually cleared : but in these cases, it would appear that a certain lapse of time is necessary for effecting the secernment and expulsion of this disordered matter, which probably has been occasioned by obstruction of the secerning orifices of the internal membrane, from vitiated films and pellicles, attracted from the long-neglected contents of the intestinal tract. With salutary discharges of this kind, the alarming symptoms of many diseases cease altogether.

CHAPTER XIV.

CONCERNING THE ASSIMILATION OF ALIMENT, AND GENERAL EFFECTS OF THE PROCESS.

A CERTAIN degree of heat seems essential to the process of digestion ; and hence it is, that warm food is, in general, more readily digested than cold ; since by artificial heat the digestion of an alimentary substance is partly performed ; or, in other words, it is rendered more pulpy.

In opposition to the idea of heat assisting digestion, it has been argued that cold-blooded animals, as they are called, digest well, although the temperature of their bodies be little higher than that of the surrounding elements. If this be indeed the case, why do they retire to such depths within the earth, at a season when the temperature of the surrounding elements becomes far lower than that of their bodies, if it be not for the maintenance of a much higher temperature than could

be supported above ground? Their stomachs cannot possibly contain a sufficient quantity of nutriment for their support during the cold season. Hence there cannot be a digestive process continually going on : and their stores for nutriment must be inquired after beyond the precincts of the digestive organs, as I have instanced in the marrow of the human subject, in the fifth chapter : and it appears not that they retire until they are incapable of assisting digestion by a much higher temperature than that of the elements around them.

The natural temperature of the human body appears to be sufficient for assisting the necessary fermentation and concoction of food in the stomach ; healthful fermentation promoting also that gradual and moderate distention of the organ, and maintaining that degree of ærial space, which is calculated to prevent inconvenience from a moderate bulk of food. It is not necessary, therefore, to dwell upon the disadvantages to digestion which are incurred by eating rapidly, by loading the stomach with heterogeneous varieties, or with

unsuitable bulk even of the wholesomest aliment. In the first instance, its muscular powers are excited too suddenly and too forcibly; the distention is not gradual; the efforts of nature to propel the contents are difficult and convulsive; the pulp is but little assimilated; the more crude parts separating from the more watery, and causing general flatulence with acid eructations and other inconveniences. In the two last instances, the determination of blood to the vessels of the head, the nervous stupor, the sense of fulness, of weight, and uneasiness about the stomach and bowels, are intolerable: and these evils are probably aggravated by a general neglect of proper bodily exercise; since indulgences in eating and drinking alone promote habits of indolence and perpetual listlessness.

The head is always morbidly affected in proportion as the alimentary canal is so affected. Indigestible crudities, separated from the watery parts of the alimentary mass, remain long in the bottom of the stomach, acting as extraneous bodies instead of nutriment, and the head suffers as

long as they remain there. Excrementitious obstructions of the bowels, which are a common consequence of bad digestion, affect the head in a still more serious way ; and if long retained produce despondency, which finally, on many occasions, assumes even a maniacal character.

The commonest observer knows that a slight degree of fever naturally follows every meal : and it is proportionably greater, as the powers of digestion are less vigorous. In the young and healthy, it is a matter of no inconvenience, and escapes their notice ; but in persons of weak digestive powers, it is more than sufficiently obtrusive. A greater or less degree of fever, according to the state of the general health, occurs regularly in the evening, which is, of course, increased by a free supper : and though a certain increase of bodily heat and circulation seems to have been ordained by nature, not only for assisting digestive fermentation, but for stimulating the system to the absorption of nutritious fluid, and the expulsion of excrementitious inconveniences, that natural degree of fever becomes insufficient, after

an inordinate meal ; and is altogether nugatory where the powers of digestion are impaired. Exercise, I therefore maintain, is the best remedy for the evil ; and if regulated according to the constitution of the patient, and the degree of bodily health, it can neither exhaust the machinery of the animal economy, nor, like too many medicines, act unchemically in the stomach ; thereby adding mischief to its contents, which are already mischievous, and totally destroying its natural tone.

What does the hectic flush of indigestion arise from, but an abortive effort of nature to promote that active degree of circulation, which is essential to the digestive process ? What is the head-ach and sense of swelling in the eyes, but a transfer from the stomach and intestines, burdened with substances which they have neither the power to assimilate or to propel ? A few hours after, heart-burn and flatulences increase the distress of the patient. Alkalis and absorbent earths, and carminatives, are had recourse to, when probably a glass of hot water, or a cup of hot tea

with a little brisk exercise, would altogether have set aside the necessity for such remedies; and, what is still more important, have left no bad effects: for to the slow and exhausting fire of nervous complaints, resulting from disorders of the alimentary canal, fuel is added by the use of spirituous and stimulating medicines, and absorbent earths. It is much better to attempt the neutralizing of morbid acidity by mild alkalis, for example soda and potass, than by absorbent earths, such as chalk and magnesia; and to obviate flatulence by bodily exercise.

I have stated that the motions of the muscles concerned in eating promote the due supply of saliva to the mouth, by their influence on the salivary glands. In like manner, I conceive, the diaphragm and the muscles of the external belly assist the respective secretions of the stomach, the liver, the pancreas, and whatever other apparatus is concerned in furnishing the fluids necessary for assimilating alimentary matter, and separating the impure material which the motions of the intestinal canal afterwards forward to its extremity;

and that this general muscular influence on the alimentary organs is assisted by bodily exercise soon after eating.

That muscular action is promoted by arterial action, is not to be denied; and that arterial action is promoted by bodily exercise, is equally certain. Nervous excitement of a salutary kind, is also promoted by bodily exercise, in addition to the stimulus exerted on the nerves by arterial action. In this point of view, moreover, change of scene and mental occupation act beneficially on the nervous system. Of all our habits, that of sitting long after dinner is most objectionable, with regard to health; and but ill accords with polished intellect and social order: since many, by indulging in this mistaken kind of hospitality, "put an enemy in their mouths to steal away their brains."

It may be said, "wine has the advantage of increasing arterial action, as well as exercise; and thus it may be as beneficial to indulge in the pleasures of the table, as to fatigue ourselves with bodily exercise or mental occupation." The arte-

rial, the nervous, and the muscular excitements, promoted by bodily exercise, are very different from such as result from the use of fermented liquors: and in what way those diffusible stimulants affect the very substance of the brain, will appear in the chapter which treats of their general qualities and effects. I am by no means adverse to the moderate use of fermented drinks; being satisfied that many stomachs, by the peculiarities of their natural tone, cannot bear the use of water only: and in such habits the stimulus of a moderate portion of wine or malt liquor is of service to the general powers of digestion. Further, where the stomach is weak, it is imprudent to use cold drinks with our meals at any season of the year: for the cold temperature alone of a free draught of water or malt-liquor, is sufficient to destroy the assimilation of the more solid and coagulable parts of the aliment with the more fluid and watery; thereby promoting the inconveniences which have been detailed, as arising from bad assimilation.

Again, it will be said that experiments have

been instituted upon animals, which prove that digestion is promoted by rest, and interrupted by exercise. That the process of digestion goes on while we are asleep, is very certain; because it seldom happens that we retire to rest, even in a state of health, without some undigested aliment in the stomach; but it is more than sufficiently evident that the quantity must be small, and not very recently eaten, to be no cause of inconvenience.

It may also be argued, that the inhabitants of hot climates make a practice of going to bed after dinner. It is the general torpor of a diseased liver, or of exhaustion from some form of fever, by influence of the climate, which seems to have instituted the practice. Moreover, it is observed at a time of day when the heat is too oppressive for occupation.

Next it may be said, "Oxen and sheep lie down after eating." A great part of their aliment is, for a long time, merely held in a sac, to be acted on by bodily heat, before it is received into the true stomach, the process of digestion in those animals being particularly gradual: and with re-

spect to the effect of exercise on digestion, it may be observed, that oxen and sheep are in motion all the time they are eating; and that, while eating, the true stomach may be influenced by their simultaneous exercise; since the food they are gathering is to be kept in store for the purpose of being re-masticated at pleasure, and then received into the stomach for nutritive offices. Does the active and intelligent horse lie down immediately after eating? or does he evince any inconvenience from continuing his journey after having been moderately fed? Do we ourselves experience any material inconvenience from a journey or long walk soon after dinner? Certainly not, except under the influence of disordered health. It is undoubted that many persons, who, in the accomplishment of tedious and fatiguing journeys, experience no sort of inconvenience to the digestive organs if they proceed soon after a meal, find their digestion greatly disordered if they allow themselves to sleep for an hour subsequent to a meal; during which time an unfavourable process of digestion communicates the most trouble-

some sensations to the head, and to the nervous system in general. Such a sleep is not uncommonly broken by the influence of an agitating dream; or under a nervous tremor and shivering of the whole frame: and the lapse of a very few minutes will furnish sufficient symptoms of a disordered stomach.

If it be maintained, not only that digestion goes on quite as well sleeping as waking, but even that the process is assisted by sleeping immediately after a meal, how can it be admitted that suppers are objectionable; and that they promote the accession of nightmare, flatulence, and all those Protean disorders, which result from indigestion and want of assimilation in the contents of the stomach? Yet it requires very little observation to satisfy ourselves that free supper-eaters suffer for their indulgence.

I maintain that all those whose powers of digestion are not energetic should avoid sitting the usual length of time after dinner, and adopt regularly some kind of gentle exercise. Every advocate for repose after eating, is ready to object

the result of an experiment made on two dogs, who after some considerable fasting were allowed to eat a full meal. One was confined ; the other immediately turned out hunting. After an equal lapse of time, both were killed ; when it appeared that the digestive process had gone on effectually with the dog that had been confined, while it had been altogether interrupted in that which had been excited to violent exercise.

I do not consider the result of this experiment by any means conclusive ; for every one must be aware of the inconvenience to the general powers of life, which must necessarily accrue from sudden and violent exercise of any kind ; particularly when an empty stomach has just been highly excited by the free accession of food. The dog left to repose, would naturally be lulled to sleep from the overpowering effects on the brain of a full meal after fasting ; while those very muscles of the hunting dog, which naturally would have been employed in assisting the process of digestion in common with regular respiration, were excited solely to the assistance of increased and violent

respiration, to say nothing of disturbance to the assimilation of the alimentary pulp, and to the muscular action of the stomach and intestines; besides a check to the healthful secretion of the fluids concerned in digestion. This sudden and violent kind of exercise immediately after eating, is as likely to prove injurious to the functions of the alimentary organs, as moderate exercise, after the interval of half an hour, or an hour, is in general beneficial. Rest seems a natural accommodation for repairing the waste of mechanical action in the animal body; exercise a natural accommodation for the assistance of its chemical and vital functions.

CHAPTER XV.

COMPARATIVE VIEWS OF THE CAPACITY OF THE STOMACH IN MAN AND ANIMALS, AND ITS INFLUENCE ON THE SENSORIAL POWERS.

THE relative proportion or capacity of the stomach to the dimensions of the general system, seems essentially to influence the mental and bodily energies of man, and of the higher orders of animals. Inactivity every where relaxes the animal fibre, whether it be the fibre of muscle or of cellular tissue ; and these have been sufficiently shown to admit of elongation, in obedience to mechanical weight, or to moving forces of any kind. The circumstance, then, of weighing down the stomach with a load of food, particularly where relaxation of the general fibre is favoured by inactive habits, must tend, by degrees, to increase its capaciousness : and in proportion as this is increased, the energies of the brain and of all the organs of sense become diminished : the

sight, the hearing, and the smell, are less exquisitely acute; the palate is not satisfied with simple viands, but requires, according to the fashionable phraseology of the day, something "*piquante*," something "*recherchée*;" and even the sense of touch is rendered less nice.

It was well observed by the late Dr. Saunders, that we are made gluttons from the cradle, by the officiousness of our nurses. A child's health is disordered from being over fed. It cries and complains from the effects; and with a view to silence it, more and more food is given, so that the evil is increased instead of remedied; and the capacity of the stomach gradually extended far beyond the salutary bounds of nature.

Both the quantity and the quality of our food should be proportioned to our habits of bodily exercise. When we have active exercise in the open air, we may with impunity eat a hearty dinner; taking care, even then, to leave off before the appetite is palled: but on days when persons of weak digestion do not go out of doors, and especially when the mind has not been energeti-

cally occupied, it would be well to abstain altogether from solid animal food, and satisfy themselves with simple farinaceous matters, in the composition of which care should be taken that eggs are as sparingly used as possible.

Nothing is a grosser blunder than that eggs are eligible for weak digestion, and for the diet of the sick. They never assimilate with the contents of a disordered stomach, but partly coagulate on meeting the gastric juice, and form various crudities; and partly generate a noxious vapour, which, under its real and offensive character of sulphuretted hydrogen, rises from the stomach into the mouth. The colouring material of the yolk of an egg is sulphur; which combining with the watery contents of the stomach, forms the vapour alluded to, after the more acid have formed coagula. It is the sulphur naturally contained in an egg, which tarnishes a silver spoon; and the sulphuretted hydrogen of an impure atmosphere which tarnishes silver in general; especially in crowded cities.

Although anxious to impress the advantages of

moderation in eating, and the evils which arise from undue indulgences, I wish also to impress the disadvantages and imprudence to weak stomachs, of long fasting; conceiving that they should never be more than four hours without the accession of some easy kind of food; and that, even in good health, an interval of seven or eight hours is by far too long.

With respect to the capaciousness and contents of the stomach, as influencing the energies of the brain and animal system at large, a very few considerations of comparative anatomy need be adduced. In the horse, which is one of the most assiduous and most intelligent of animals, the stomach is remarkably small, in proportion to his general stature and the dimensions of the alimentary canal. By natural habits, he does not eat greedily, though frequently. However great the quantity of food he consumes in a given time, it is received very gradually into the stomach: and it is only under the inactivity of age, or of some casual disease, that he is ever greedy. In the slow moving ox, and sheep, there are no less than

four stomachs; the three first of which are preparatory sacs of different internal organization; and the food, before it is received into the fourth or true digestive stomach, is regurgitated, to be more duly prepared for assimilation with its juices. In either animal, the salivary glands are very large; and repeated mastication, with an abundant supply of saliva, seems necessary for promoting that digestive power, which more active motion would have assisted materially. Though the absence of teeth in the upper jaw, is not alone sufficient to account for the necessity of these animals regurgitating their food, it seems possible that the increased accession of saline matter from the salivary glands by repeated mastication, after the assistance of heat and moisture in the preparatory receptacles or first stomachs (the temperature of fresh herbage being much lower than that of hay or grain) may chemically supply the place of such adequate mechanical division as is effected by more numerous and powerful teeth.

It is further remarkable, in the economy of the horse, that food remains but a very short time in

his stomach; whence, after mixing with the gastric juice, it is soon submitted to the influence of biliary and pancreatic juice in the duodenum, as in the human subject; digestion proceeding just in the same manner. The tract of intestines in a horse commonly measures twenty-four yards; and the diameter of the large intestines is exceedingly great, in proportion to that of the stomach and small intestines. Judicious managers of horses take care that they are not long without eating, and at the same time that they do not load their stomachs at a single feeding. The sympathy between the stomach and head of the horse is particularly striking in that disease vulgarly known as the "staggers," which is the result either of sudden over-feeding after long hunger, or of some morbid cause, by which the stomach has collapsed, through want of that moderate aërial distention, which is essential to its well-being. On the sudden accession of food, the stomach and intestines take on a convulsive action. This convulsive action is transmitted by the nervous system

to the head, causing those violent agitations of the frame and affections of the brain, by which the existence of the animal is often terminated.

A horse, like a man, breathes with difficulty after a full meal; because the distended stomach forces the diaphragm against the general substance of the lungs, compressing their air cells, and diminishing their general capacity: but after a moderate meal, on the contrary, he is benefited by well regulated exercise.

In dogs, the stomach is of comparatively small dimensions: and the intelligence of these animals is conspicuous in every breed, except where they are over-fed; their general health and acuteness of instinct diminishing in proportion as they are pampered.

From the highest to the lowest orders of animals, gradations may be traced which establish the position, that as the stomach is large in proportion to their general dimensions, the moving powers are less free, the sensorial powers less exquisite. Certain of the worm tribe, for ex-

ample the common leech, are entirely stomach, their interior being merely divided by membranous folds. The *hydatid* is only a globular stomach with a mouth; and certain of the more minute animalcules, as the *volvox globator*, appear to be of similar structure.

CHAPTER XVI.

OF THE RECIPROCAL NERVOUS SYMPATHIES WHICH EXIST BETWEEN THE BRAIN AND ALIMENTARY ORGANS.

VITALITY is a term under which, by the limitations of human intellect, it is often necessary to comprehend those arcana of physiology which nature does not permit us to penetrate: for it must be remembered that "words are the daughters of Earth, and that things are the sons of Heaven."

That the process of digestion is both chemical and mechanical, seems sufficiently established: but the chemistry and machinery which are regulated by the vital principle, are such as cannot be imitated by human ingenuity: all attempts at illustrating digestion by chemical agents, out of the living stomach, having hitherto amounted to nothing; and as the several secreted fluids which are naturally concerned in the digestive process

are insufficient to establish its history beyond the details which have been offered, the observation of effects must satisfy us, while the cause in part remains obscure.

Though fermentation takes place in the stomach and intestines, and we know its qualities and effects to be greatly modified by particular kinds of aliment, still that fermentation is different in its kind from any which takes place without the assistance of *animal life*: and although we know that acids are formed in the stomach by a fermenting process, still those acids have hitherto appeared different from any which can be formed by art upon substances similar to those which are acted on in the living body. Nevertheless, such acids are capable of being neutralized by simple medicines, and the inconvenience to health from morbid acidity accordingly relieved.

That the nervous system is especially concerned in the process of digestion, attentive observation is sufficient to establish: and in proportion as the nervous system has difficulties to contend with, is the process of digestion imperfect. Difficulties

may be opposed to the due exercise of nervous influence, by imprudence in the use of unsuitable aliment; by the casual accession of mental disturbances in all their varieties; and by bodily disorders, whether arising from irregularities of habit or local injury.

It is remarkable, that while wounds of the stomach can be made to heal in a favourable way, blows upon the organ, and those not the severest, readily prove fatal. The operation of these effects must be referred to the nervous system, though it is difficult to comprehend in what manner it acts; since the brain and more conspicuous parts of it sustain far greater injuries without serious consequences. Violent injuries of the diaphragm too, have been sustained without any fatal result.

We know that sudden intelligence, which alarms or rejoices us, or the sudden accession of any powerful impression, makes us forget hunger; that a fatigued and hungry horse is readily excited to complete forgetfulness and activity on hearing the hounds; and that he will go through a long chase with alacrity, notwithstanding his

previous exhaustion. We know, too, that under extreme mental depression from disease and pain, cheerful society will so far awaken our animal spirits, upon some occasions, as to lead us into energetic conversation; but it is to be remembered, that these excitements are not effected without very considerable expense to the constitution, through the exhaustion they afterwards occasion: the exhaustion is that of the nervous system, and the whole animal economy suffers until the natural tone of the nerves is restored. Affections of the nerves produce affections of the stomach and alimentary organs. Affections of the stomach and alimentary organs are equally active in producing affections of the nerves.

Under a desire to enforce the sympathy between the stomach and entire nervous system, and particularly the head, I thought it eligible, at the outset of these considerations, to define the stomach, the centre of the nervous system. The general sympathies communicated by this organ have arrested consideration from days of old. In those times it was not unfrequently regarded as

the seat of the soul, and in recent times the opinion has been adopted by Mr. John Hunter. For my own part, I only venture to speak of demonstrable facts, the due consideration of which alone seems calculated to direct our views of the animal economy, and regulate professional practice for the aid of its disorders.

So many illustrations are on record of the different senses depending altogether on the presence and operation of nerves, that it is scarcely necessary to adduce an example in this place. One however, which came under my notice, may as well be given.

An old Hanoverian, whose constitution was exhausted by a neglected disorder which often affects the bones of the head, had for many of his latter years lost entirely the sense of smell. On examining his head after death, the ethmoid (sieve-like) bone, which is naturally furnished with numerous minute openings for the transmission of branches of the olfactory nerves from the brain to the nose, was altogether condensed, and its openings obliterated; the two primordial

trunks of the olfactory nerves, instead of exhibiting their usual ramifications, being suddenly blunted at their extensions from the substance of the brain; plainly showing, that all their branches essential to the sense of smell had been completely destroyed by the diseased bone: and accordingly that the sensorium could not have been influenced by any perception of odour; the impression of which naturally travels from the numerous branches of nerve within the nose, through the ethmoid bone, to the trunks which proceed directly from the brain.

Nerves are evidently of fibrous structure, but not elastic; their ultimate fibres appearing, like those of tendon, to be constituted by an aggregation of minute dense filaments, as is apparent in their lacerated extremities. These filaments being dense admit of no elasticity; for which quality, it will be remembered, a tubulated structure seems provided by nature in every kind of animal fibre required to exert it. If there be any exercise of elasticity in nervous fibre on occasions of ex-

treme flexion and extension, the accommodation for it seems to be constituted by slight wavings of the longitudinal fibre: but the quality, if it does exist, is very limited.

Nervous fluid, or whatever that rare and elastic matter may be, which communicates sensation from one part to another through the medium of these ramifications of the brain, probably follows the tract of their fasciculated fibres, maintained in its due course by the membranous sheaths with which they are every where furnished.

The chief difference of external character between lymphatic glands, and those united bodies of nerve which are called ganglions (for in many instances they are scarcely to be distinguished otherwise), is, that lymphatic glands, which appear to be formed of convoluted tubes, are compressible; while ganglions, or, in plain English, knots of nerve, are not compressible, by reason of the density of their constituent fibres.

Ganglions are not uncommon in the course of nervous ramifications: and when the branches of

different nerves are interwoven in a perplexed net-like manner, they constitute what is technically called a *plexus*.

The stomach, and all the organs which have been described as concerned in the digestive process, are profusely furnished with nerves, not only in the form of branches, but of the most intricate plexuses and ganglions; by which means, they connect themselves with that great continuation of the brain, which is called the spinal marrow; and for the protection of which, nature has provided a strong articulated pillar of bone, commonly distinguished as the spine; and there is, moreover, a direct communication with the brain by delicate ramifications of its substance, independently of the spinal marrow.

Under these considerations, it becomes needless to speak more at large of the media which exist for the communication of nervous sympathies from the alimentary organs to the head; or, by physical influence of the sensorium, from the brain to the alimentary organs.

CHAPTER XVII.

OF ACIDITY OF THE STOMACH—SEA-SICKNESS
— FLATULENCE — NIGHTMARE—NERVOUS
EXCITEMENTS.

ACIDITY of the stomach varies as to its general qualities, effects, and impressions in different individuals; being considerably modified by habit of body, and habits of life with respect to occupation as well as diet. A vulgar error prevails, that the actual presence of bile in the stomach, is essential to the production of those acid qualities of its contents which cause such a variety of distressing sensations: whereas, in reality, bile but seldom lodges in the stomach itself; for it will be remembered that a retrograde muscular action is required to transmit it thither from the duodenum: and this retrograde action is commonly induced by vomiting. Vomiting repeatedly excited, in disordered states of the stomach, often brings for-

ward bile of a vitiated character, mixed with the no less vitiated mucus and watery fluids of the stomach; but it is to a morbid state or secretion of the gastric juice, or to the unwholesome productions of unassimilating objects of aliment that acid, acrid, and burning sensations are generally to be ascribed.

The muscular action not only of the stomach and intestines, but of the whole abdomen and organs of respiration, is so powerfully excited by efforts to vomit, that emetics can scarcely be used with prudence in some constitutions, by reason of the great exhaustion they occasion, to say nothing of certain muscular injuries which may be incurred.

After repeated ejections from the stomach, it is well known, that very frequently, nothing but genuine bile makes its appearance, which is easily accounted for by the retrograde action of the duodenum. This is particularly the case in the continued efforts of sea-sickness; and those who have suffered from it, in the severest way, know that they are compelled, by an irresistible impulse,

to make the most violent efforts, while they feel certain that the stomach contains nothing but air. The result is a very trifling ejection of clear bile ; for the production of which, the very substance of the liver feels wrung like a sponge, and as a dead weight suspended from its ligaments, drawing down the diaphragm upon the empty stomach and intestines.

However salutary sea-sickness may be in some diseases, such violent degrees of it as are induced by rough weather, occasion serious exhaustion to constitutions which are not the strongest ; and for the recovery of which, much time is required. It is idle to say that the physical cause of sea-sickness is altogether mental ; because, many persons who are good sailors in tolerably rough seas, find themselves overpowered in great storms : and I have observed this to be the case even with experienced seamen. Those also, whose stomachs are, by habit, not the most vigorous ; while their minds are perfectly composed, and indifferent to the inconveniences around them, become overpowered even by easy movements of the vessel ;

such being quite sufficient to disturb the process of digestion: and besides the constitutional tone of the stomach, the nature of its contents previously to coming on board, has a great influence on the violence of sea-sickness and its readiness to occur. I regard the attendant affections of the head as purely sympathetic, from the disturbance of the alimentary organs.

It is in vain to expect relief from strong liquors or from opiates. An inclined position appears to be of more assistance than any thing else: but the advantage of providing for different degrees of inclination, seems never to have occurred to the builders of passage-vessels; the births being commonly quite level. If, instead of this, they formed moderately inclined planes, it would be a great comfort to those who suffer severely from sea-sickness. Or, it would be still better, if each birth, remaining level, were furnished with a hinged floor, which may be raised to a greater or less degree, at pleasure, by means of an interposed prop; the position of the body on an inclined plane, being particularly calculated to obviate the

bad effects of that powerful determination of blood to the head, which is occasioned by repeated strainings from a tormented stomach. The cravings of hunger should be gradually satisfied after sea-sickness; since the circumstance of filling the stomach at once, is likely to be the cause of such annoyances as have been heretofore described, when considering the process of digestion. Costiveness very commonly follows these commotions of the alimentary organs, from the circumstance of bile not being duly furnished to the intestinal tract, on account of its exhaustion by vomit; whence due assistance should be afforded, by means of aperient medicines.

For the reasons just now mentioned, it appears to me eligible, in all affections of the stomach, to try the effect of purgatives, before emetics are had recourse to; since they have the advantage of speedily relieving, instead of disturbing the head; and are, in a general point of view, less exhausting to the nervous system.

Besides the direct retrograde muscular action of the duodenum, there is another medium through

which bile may find its way into the stomach in a less genuine form ; namely, from its exhalent vessels, after having been received into the general volume of blood : but the acids which occasion the greater number of inconveniences, are mostly the result of bad assimilation, and morbid fermentation of the alimentary contents of the stomach.

We are led, as it were, by instinct, to the use of farinaceous and saccharine aliment from the vegetable kingdom, although the latter principle exists also, to a certain degree, in animal food. The sugar and mucilage of vegetables, which we are accustomed to use both in the solid and fluid forms, promote, with the assistance of heat, a process of fermentation, of which *acid* is the necessary result. Animal food, for which we have in general a strong propensity, has an *alkalescent* tendency ; by which, undue fermentation is checked : and when we observe moderation in the use of both, the degree of fermentation that may prevail in the digestive process, is unlikely to be of a morbid kind. It too commonly happens, however, that persons of delicate habits imagine

they may use with impunity, the same kinds of aliment as those of robust health. But instinct (the voice of God, as it is truly called) instructs the temperate in the choice of such aliment as may assimilate favourably; and from the same powerful monitor, we may often learn that bad assimilation is the result of bad habits.

Putrefaction is the last stage of the fermenting process; and if the bile, besides the salivary and gastric fluids, were not of an antiputrescent as well as of a stimulating quality, the crude material could not be separated from the nutritious, without offence to the system, in its passage through the intestinal canal.

The ancient pathologists had many vague theories concerning fermentation in the circulating fluids; but of this there is no sort of evidence. I only wish to establish its salutary influence in a limited degree, on the assimilation of aliment, and on the promotion of a moderate distention of the alimentary canal; and its mischievous effects, when inordinate, in promoting flatulence and undue distention; as well as a disordered state of

the chyle, which is capable of affecting all the fluid secretions. For, whatever degree of morbid acidity or alkalinity in the circulating fluids may occasion eruptions of the skin and other disorders of the extreme vessels on exhalent surfaces, it must arise from the chemical effects of the alimentary pulp, in its course of animalisation, whether those effects be modified by the species and qualities of food and drink, or by the peculiar state and action of the alimentary organs, either individually or conjointly; and not from any fermenting process of the circulating fluids, after the chyle has been absorbed from its primordial sources.

The doctrines of predominating acidity and alkalinity in the animal system, have experienced opposition which the more recent inquiries of chemistry instead of invalidating, are daily tending to establish.

Morbid acidity of the circulating fluids evinces itself under various kinds of cutaneous eruptions; and morbid alkalinity most especially in scurvy. I have uniformly found slips of paper tinged with

vegetable blue readily become green on being applied to the sanies of scorbutic sores; and those coloured with turmeric become brown. In these instances, the use of muriatic and citric acids, with careful attention to the alimentary canal, the total prohibition of salted, and a very limited use of any animal food, has been successful beyond expectation. To name an example—An artificer, who had been afflicted with troublesome scorbutic maladies for upwards of two years, during which time he had in vain adopted the remedies advised by different practitioners whose ideas as to the nature of his disease were also different; and without any particular attention to diet, became desponding from the failure of expected relief. His tongue and throat were ulcerated, the gums spongy, the breath offensive, the whole system languid. By adhering strictly to a regimen directed by the foregoing maxims, and without any local applications whatever, he perfectly recovered his general health and soundness of body at the end of six weeks; and by prudence in dietetics, has not experienced the slightest return of his

complaint for the last six months. The acidity of weak stomachs, on the contrary, seems frequently relieved by a diet mostly of animal food : but this requires to be carefully regulated, and assisted by proper aperients, with a judicious use of alkaline medicines : for it is evident that animal food, when used too largely, communicates a morbid degree of alkaline stimulus to the whole system.

Whatever causes indigestion, causes flatulence. When the passage of wind from the stomach is prevented by a spasmodic constriction of its upper orifice, a sensation is produced of a ball forcing its way upwards, as if about to suffocate ; and from which hypochondriacs draw very alarming inductions. As the cause commonly rests in an injudicious choice of aliment, and want of exercise, it is in the power of most persons to evade the effect.

The flatulent dropsy, which also is called *tympanites*, because it makes the abdomen tense like a drum (*tympanum*), proceeds from a far more serious cause : for instance, the mechanical com-

pression of tumours, the evolution of air from mortification of the bowels, or from long neglected costiveness, when the obstruction has become too great to be removed by any administration of art.

Flatulence often exists in a latent and obscure way, giving origin to painful sympathetic affections of the chest, resembling spasms, and communicated through the medium of the diaphragm to the back; besides a sensation of giddiness and light-headedness, which for the moment seem unaccountable: and the effects of this disorder are far more various and more serious than is generally imagined, since it often occurs after the alimentary organs have been well regulated; and in particular when depressing passions have prevailed. Still, however, the quality of aliment is most commonly in fault.

When the action of the bowels is sufficiently free for the general well-being of the system, much relief from the inconvenience of obstinate flatulence is obtained, either by a warm bath, or by very active exercise, even to fatigue. In some subjects the former is preferable; in others the

latter, particularly in hypochondriacs, who often find their animal spirits perfectly re-established as soon as flatulence is subdued. By the partial contractions of the intestines, which take place under this disorder, the figure of the alvine evacuations is much influenced; and their natural appearance does not return until it has been relieved. It may even be a cause of intus-susception; it is insidiously active in the increase of incipient hernia, and is certainly a frequent, if not a general promoter of scybala.

From many circumstances and considerations, I am led to conclude that nightmare is, not uncommonly, the sole result of flatulence; unattended by which, the malady seems never to occur, even when derangement of the nervous system is sufficient to account for it. That this "pestilence of darkness," which in distant times was so much dreaded, that prayers against it exist in the old Catholic books, is the offspring of a disordered stomach, there is no doubt: and it takes place not only where offensive food has been carefully

avoided, but even after repeated evacuations by purgatives, when disordered contents of the stomach and bowels cannot possibly have exerted either a mechanical or chemical influence on the nervous system, and while the animal spirits are not depressed. The painful sensations of this disorder appear, therefore, to depend entirely upon spasmodic contractions of the stomach and intestines, whether partially or generally; the sense of suffocation, and irregular action of the heart and arteries, which always accompany it, resulting from a mechanical compression of the lungs, effected through the convulsive forcing up of the diaphragm by the distended stomach and bowels. The malady affects abstemious and temperate livers, as well as free livers and supper-eaters. As far as the recent contents of the stomach are concerned, the flesh of young animals is not without its influence: and very young lamb, which most persons are disposed to think harmless, is as active in producing this and many other kinds of internal mischief, as veal, pork, and various other

kinds of food, which are well known to be offensive to weak stomachs : but it is difficult to enforce a belief that, by eating as well as drinking, such a derangement of sensorial perception may be induced, whether sleeping or waking, as to conjure up the most hideous forms and terrific phantoms, and to torture the whole system also with the most appalling views of the known world as well as the world unknown.

The aberrations of intellect occasioned by the unsuitableness of food to constitutional peculiarities, are always, in a greater or less degree, of a desponding turn ; because the inconvenience to the nervous system is of a sedative nature : and while the more diffusible effects of fermented liquors exhilarate for a moment, the time is not distant when they must, in like manner, become sedative. Feebleness and exhaustion succeed the fallacious vigour of irregular excitation : and it is especially, by the finally sedative power of hard drinking, that indurations of the liver are occasioned, by reason of the languid circulation thus

induced in its extreme arteries. The animal spirits fail, the voice becomes hoarse, the powers of digestion are irrevocably lost, and yet the deluded victim continues to seek exhilaration from the same unhappy source, forgetful that each step leads him nearer to destruction.

CHAPTER XVIII.

CONCERNING THE VENTRICLES OF THE BRAIN AND ITS COMMON SUBSTANCE—OF HYDRO- CEPHALUS.

THE BRAIN, which from its superior proportion in man places him at the head of created beings, is of a structure different from any other substance of the animal economy: for although the ramifications of nerve which we can trace from it are of a fibrous structure, yet, on account of its dense pulpy texture, we can only judge by analogy that the brain itself is fibrous. Dr. Cullen regarded it as a gland; but it is unlike any other animal matter in the form of a gland.

The whole substance of the brain is compressible; for the existence of which quality an elastic kind of matter must be engaged; and as the fibre of the brain, if it be solid like the fibre of nerve, would only admit of flexibility instead of elongation and contraction, the matter which occupies the portions of space between its ultimate solid

fibres must be either fluid or aëriform, to admit of compressibility. It seems possible that this matter may be a peculiar secretion of the brain in the form of halitus, after the manner of that which is generated by the lungs.

In the primæval cultivation of anatomy, each of the principal inclosures of the vital organs, namely the head, chest, and abdomen, was distinguished by the term *venter*, or belly : and any minor cavity of the individual organs, by the diminutive term *ventricle*.

The common mass of the brain divides itself lengthwise, nearly to its base, into two kidney-shaped bodies, distinguished as its hemispheres ; at the under and back part of which it forms a roundish double-lobed body, called the *cerebellum*, from which the spinal marrow is extended ; these several objects being no other than divisions of one entire substance, varying in their modifications, as is clearly seen at the common basis of the brain.

Each hemisphere of the brain has a longitudinal cavity commonly known as the lateral ven-

tricle, in contra-distinction to two smaller cavities which are near them. These lateral ventricles I am disposed to regard as the sources which nature has furnished for the reception of that halitus which regulates the compressibility of the general substance of the brain: for, as elastic matter is essential to the maintenance of those yielding qualities which the brain is called upon to exercise, according to the greater or less distention of its blood-vessels and other causes, there must, of necessity, be some provision for those different degrees of density which the halitus of the brain at large must experience in the functions of life; but above all, from different states of the sanguiferous system, which are modified by the stomach and alimentary organs; as well as from the excitability of the brain itself and nervous system.

The brain is so abundantly supplied with blood-vessels, in its natural and healthy state, as to convey an idea that a more than common accession of blood is essential to its functions: and as this natural supply of blood is evidently great, it is easy to conceive how a diseased fulness of the

sanguiferous system so readily and so rapidly affects the brain, as is instanced in apoplexy and other diseases.

The ventricles may be regarded as little caverns, which appear to support the great bulk of the brain above them, on the principle of an arch, collecting halitus for the maintenance of its due firmness, and fitted to be the reservoirs of any superfluity of that rare and subtile matter, which requires some receptacle when the substance of the brain is compressed. May not this halitus be the invisible and undemonstrable matter we call nervous fluid? May it not be condensed into a fluid form in the ventricles, for transmission throughout the nervous system?

If a healthful brain be examined after death, the quantity of fluid contained in the ventricles appears to be so inconsiderable, that it would seem by no means an extravagant speculation to regard it as condensed vapour: but a diseased brain often exhibits very different appearances.

The circumstances which cause a morbid accumulation in the ventricles, appear far more nu-

merous than is generally imagined, the quantity being probably influenced altogether by the healthful or disordered state of the circulating system ; the quality, by the stomach and alimentary organs.

Hydrocephalus, or watery head, as it is commonly called, is a disease of general debility and languid circulation ; although some pathologists have regarded it as inflammatory. I conceive it is strictly to be classed among the numerous progeny of *Scrofula*, having never seen it unaccompanied by some characteristics of the disease : and although it occurs mostly in children while their bones are yielding, it also occurs long after they have attained their full degree of firmness in scrofulous habits. It is a mistake that scrofula is necessarily derived from hereditary infirmities. I have again and again found it undeniably established in children who have descended from healthy parents ; and incurred by adults whose habits of life have debilitated the animal powers in general. It is in fact a result of universal debility. The morbid accumulation of watery fluid

in the internal hydrocephalus distends the ventricles of the brain to various degrees, often destroying their general arrangement and natural figure: and, in like manner, they are unduly distended, and influenced as to their contents by a disordered stomach, as will become evident in next chapter.

CHAPTER XIX.

OF THE QUALITIES AND EFFECTS OF FERMENTED LIQUORS AND OTHER DIFFUSIBLE STIMULANTS.

THE old physicians had much to say about rawness and soreness of the stomach, by which terms they clearly meant to express those uneasy sensations which result from a morbid fermentation of its unwholesome contents. They also talked of the transfer of particular vapours from the stomach to the ventricles of the brain: and although a love of innovation, as well as an insufficiency of research, may have caused their ideas to be treated with levity in recent times, they will be found, upon mature deliberation, to have been founded on the evidence of reason and experience.

That the abuse of fermented liquors causes an actual transfer of their volatile matter from the stomach to the brain, facts are not wanting to prove; and after my adducing two striking evi-

dences in particular, it will not be difficult to conceive, that *intoxication depends on an actual transfer of volatile spirit from the stomach to the brain*, and that errors of perception and general derangement of the sensorium, under the influence of strong liquors, are produced by the direct agency of such diffusible matter on the substance of the brain and particular nerves.

1. A healthy man about thirty years of age, having fallen down from intoxication, and died within three hours after the accident, without any sufficiently characterised symptoms of an injured head, besides insensibility and stupor, his remains were attentively examined on the following morning, by Mr. White, of the Westminster Hospital, with myself and others; when the skull presented no marks of violence, and the blood-vessels no extraordinary degree of turgescence. The substance of the brain, which had the most healthy appearance imaginable, was progressively separated in the common way without any unusual occurrence. On arriving at the ventricles, however, a strong smell of gin was

emitted; and they contained a preternatural, though not very large, quantity of fluid which had powerfully the same smell. Our next object of examination was the stomach, and this was found to contain a considerable quantity of undiluted gin. By intelligence afterwards gained, it appeared that the man had agreed with his fellow labourers, in an hour of idleness, to drink an entire quart of gin for a wager. He accordingly swallowed that quantity at a single effort from a porter-pot, and fell within a quarter of an hour afterwards; when he was conveyed to the Westminster Hospital. It is remarkable that the corpse never stiffened previous to interment; and the countenance was rather that of a person sleeping than dead; which circumstances of relaxation seem referable to the diffusion of alcohol throughout the exhalent system.

2. I was requested by some medical students to demonstrate the anatomy of the brain upon a subject who had died on the day before; and as to the cause of whose death, no particulars whatever were known. The process went on without

any unusual circumstances until the ventricles were opened, when I was struck by the emission of a strong smell of asafœtida. Unwilling to trust my own perception, I asked the three gentlemen present, if they perceived any remarkable odour; when they simultaneously said a powerful smell of asafœtida was emitted the moment the ventricles were exposed. Inquiries were now made, as to the latest medicines which had been administered; when it appeared that tincture of asafœtida had constituted a considerable part of them.

Although I am not aware of any circumstances precisely similar to these having been published heretofore, the fact of volatile spirit being transferred through the medium of the circulation, in an unaltered state, from the stomach to the ventricles of the brain, is not more remarkable than several other phenomena of the animal economy, which are more commonly observable. It seems, in fact, but a modification of secernment or secretion: and I should not have had the presumption to state these facts publicly if attended by any

circumstances of equivocation ; nor even without the support of a more competent and experienced witness than myself.

Glandular bodies strain tears, saliva, mucus, bile, urine, and other watery fluids from the common mass of circulating blood, perfecting the particular qualities of each, in cavities of their own particular substance : and in like manner the brain seems to abstract æriform matter for the distention of its ventricles ; and for other offices of the animal economy—perhaps for the service of the whole nervous system, as I have ventured to hint in the last chapter.

Every one who has used rhubarb either in the form of powder or of tincture must have remarked how soon the urine becomes powerfully coloured thereby : nor can it have escaped the observation of any person who has eaten asparagus, that its peculiar smell is readily communicated to the urine : and this secretion is a more advanced step of the circulating system than that of the brain : and although the idea has been objected to, that the delirium which attends obstinate suppression

of urine, when perspiration cannot be excited, depends upon the exhalation of its more volatile constituents in the ventricles of the brain, the two cases which have been stated serve to render the conclusion very probable.

Mr. White has obligingly furnished me with the case of a boy about eleven years of age, who became his patient after having wounded the urinary bladder in a severe accident from scrambling over a fence. In the course of the day, the urine had diffused itself through the cellular structure on each side the abdomen and the thighs. In the night, very active delirium supervened; and the state of the boy appeared hopeless. By an operation similar to that of lithotomy Mr. White made an opening into the bladder; the fluid thrown out of its course was dispersed; the boy became perfectly sensible in the morning, and, after a lapse of several years, is at this time in perfect health.

As ammonia is contained in the urine, it probably constitutes the volatile matter which affects the brain. People advanced in life who die from

suppression of urine, are commonly comatose, and in this state breathe their last.

It is evident that chyle, on being received into the blood, is readily conveyed to the lungs; as is instanced in the odour of onions, garlic, and other strong-smelling objects of food. Carbon and hydrogen appear to be imparted, to the chyle by the vegetable part of our aliment. By the office of exhalent arteries, both are exhaled from the lungs, after having entered the blood; the hydrogen evincing itself in the moisture of the breath, the carbon becoming evident by chemical analysis. It also appears that purulent matter finds its way to the heart from a distant spot, through the medium of the circulating blood, as has been noticed by Mr. Hunter and other valid authorities: yet it is evident that purulent matter is no more a natural part of the circulating blood than gin or any common modification of alcohol.

The diffusion of bile over the whole surface of the body by means of the exhalent arteries, is familiar to every one, in jaundice: and exhalent arteries seem as much destined for straining and

diffusing extraneous matter from the common mass of circulating blood upon broad surfaces, as for abstracting the healthful secretions of particular glands under their other character of secreting vessels. In the form of halitus, an insensible transpiration is perpetually passing from the whole body. Under increased excitation, as by exercise, this same halitus condensed, becomes a fluid perspiration. In fatal diseases, perspiration often labours to pour off the offensive matter of struggling nature—in diseases not fatal, its relief to the system is universally familiar.

The transfer of diffusible stimulants in the form of medicine, from the stomach to the brain, points out the expediency of pausing, before we prescribe the free use of them, when it is an object to disturb the tranquillity of the sensorium as little as possible. Narcotic medicines appear to act on the brain in the same way as fermented drinks and spirituous medicines: and they ought to be avoided as long as may be prudent. Nevertheless, the moment too often arrives, when they must be had recourse to, as a *dernier ressort*, for

the relief of desperate or long continued pain. If it be an object, that they should take effect rapidly, they are probably most eligible in the form of tincture, a slight acetous combination being often of advantage: but where a speedy effect is not the express object, they are preferable in the form of extract. It is well known, that persons who experience delirium, attended by the most terrific phantoms, from the use of liquid laudanum, which is nothing more than crude opium dissolved in spirit of wine, suffer no sort of mental disturbance, or morbid excitation, from using the purified extract; its effects being soothing, and productive of refreshing sleep; whence it appears, that the more volatile powers of the tincture, acting readily as a diffusible stimulus, occasion unequal excitement of the nervous system, and the mind is influenced accordingly; while, the narcotic qualities of the extract exerting a more even and gradual influence, the sensorial functions are soothed and balanced, rather than disturbed.

Although this may appear a refinement to some, yet the circumstance has been abundantly veri-

fied in the course of my practice; and most especially by a lady of quality, who being driven to the use of opium from protracted sufferings, uniformly became affected with active delirium whenever she tried an ordinary dose of laudanum; but always experienced refreshing sleep, with very considerable mitigation of pain, after using the extract.

The most destructive class of fermented liquors, commonly known as spirits, are all to be regarded as modifications of alcohol or spirit of wine, more or less diluted, and flavoured with extraneous matters, according to the interests of caprice or avarice. In the stomach, they destroy its natural powers, and progressively those of every other alimentary organ. Separating from the common volume of circulating blood, their volatile parts undermine the sensorial powers, by collecting in the ventricles of the brain. The circulating system and the nervous system impaired by the use of them, the muscular powers fail; and all the infirmities of extreme age are prematurely incurred. Inordinate drinkers find their heads less and less

readily affected by the exhilarating stimulus of spirituous liquors, as they continue to indulge in them, because, through the enfeebled state of the stomach, they are more slowly received into the circulating blood ; and because the circulation itself, being rendered by the same cause progressively more languid, requires more powerful stimulants to excite it.

Wines may be classed next to ardent spirits, with regard to the mischief induced on the living system by the abuse of them. They all contain a combination of ardent spirit, the proportion of which depends on the degree of fermentation they have undergone, according to the greater or less saccharine qualities of the fruits from which they have been made, the proportion of saccharine material being greatly influenced by climate, soil, and culture ; and the degree of acid they possess, by the mode, as well as the degree of fermentation to which they have been submitted, and the interval of time after which they have been bottled. Further, some little space is observable in all bottles. That space is, of course, originally occupied by

air, which, besides influencing the deposition of extractive matter, is also an additional cause of acidity. However assiduously wine-bottles may be corked and sealed, a great part of the spirit contained in the wine will escape in the course of time, by reason of its subtilty : and hence it is, in a great measure, that wines which have been long in bottle are of milder flavour, and less mischievous quality, than those which have not had the advantage of time. The evaporating spirit partly appears to mix with the resinous matter of the seal ; and hence the wax is softened after some length of time. It seems that no ordinary glass is of texture sufficiently dense to retain altogether the volatile spirit contained in wine ; and moreover, the acid of many wines is sufficient to occasion a partial decomposition of common glass. The cork has sometimes more aroma than the wine contained in the bottle. Thus time appears to render wine less spirituous and volatile, except under particular circumstances. Spirits in general are more powerful under low temperatures : and therefore the same kinds differ as to strength in

cold weather and in hot. The weight of cold air and cold temperature is adequate to lessen, if not greatly to suppress, the volatility of alcohol and aroma in all wines.

The carbonic acid which gives life and freshness to fermented liquors in general, is likewise suppressed by very low temperatures. Hence the advantage of placing certain wines, as well as bottled porter and cyder, for a few minutes before the fire in cold weather, for the purpose of calling the fixed air into action.

The weight of external cold limits the evaporation of internal air of a higher temperature; and hence it is that cellars and natural caverns are warmer than the surrounding atmosphere in winter. In summer, on the contrary, while the external air is warm, the air contained in masses of mineral matter is so slowly evaporated, that a body of air existing in a cavern, or in a deep or thick-walled cellar, has the advantage of maintaining itself cool for a length of time; and the temperature of such places accordingly varies in proportion to the porosity of their surrounding

masses. The circumstance is further observable in cathedrals, and other massive buildings ; for example, St. Paul's in London, St. Peter's at Rome. The Monte Testaccio near the latter city, which is formed entirely of broken pottery from the ruins of ancient Rome, and which in the progress of time has become covered with alluvial matter and turf, is among the best illustrations of this fact. It is accordingly a celebrated depository for wine ; and in the overpowering heats of a Roman summer, is an evening resort of the languid Italians for the luxury of a cool drink. "Ognun sa," says Vasi, "che l'uso de'vasi di terra era frequentissimo in Roma, adoprandosi per conservare le acque, i vini, gli oli, le ceneri de'morti, e per infiniti altri usi : onde non è difficile a credere, che nel corso di tanti secoli, si sia formato un monte dell' altezza di palmi 240 circa et di 740 di circonferenza. La proprietà mirabile di questo monte è, che nell' estate esce da' frammenti, nella parte infima, un vento freddissimo ; e perciò vi sono state fatte molte grotte, nelle quali il vino viene notabilmente rinfrescato."

The richness of wines is in proportion to the saccharine matter they retain after fermentation ; and they are of thin acidifying quality, in proportion as this constituent is less abundant. The tartar which is formed in wine casks and bottles is an acid concrete salt, derived from the juice of the fruit ; the colour of it, as well as of the wine, being derived from the skins. Hence, colourless wines are sometimes made from red grapes, by using such a degree of pressure only as is sufficient for separating their pulp without depriving the skin of its colour. The tartar of wine is a supertartrate of potash ; and, when purified, constitutes common cream of tartar. The separation of tartar from the body of the wine, is another cause of old wine being milder than new.

Besides brandy, and similar spirits, the materials employed for adulterating wines previous to their importation, do not appear so mischievous as prejudice has represented ; many of them being perfectly harmless : for example, to communicate flavour to certain kinds of claret, and other light wines, it is not uncommon to suspend a nosegay in the cask for a limited time, sometimes consist-

ing of different flowers, sometimes of one kind only, as mignonette ; or the blossoms of particular fruits ; those of the grape itself not being unfrequent. Bitter almonds may be classed among the harmless matters of this kind, since about two ounces are considered sufficient for imparting the desired flavour to a cask of wine. Next to these, peach leaves are used with a similar view : but they are far more objectionable, as are also the husks of walnuts, which, besides the walnuts themselves, are among the matters employed to this end.

Much more has been said of the free way in which acetate of lead is used in the manufacture of wines than can generally be supported by facts. The process of fermenting wines appears to require very minute attention ; and it must be remembered, that the favourable or unfavourable circumstances attending it, are necessarily much influenced by the season : for, in proportion as it is rainy and cold, the fruit will be acid and watery ; and saccharine in proportion as it is warm and genial. It appears, moreover, that the acetate of lead is used in such a very cautious

way, for correcting errors through causes of this kind, that it cannot exert such mischievous qualities on the alimentary system as have frequently been ascribed to it. Where ill effects have resulted from the influence of lead upon the stomach, through the medium of wine, it far more commonly happens, that the injury may be ascribed to the reprehensible practice of using shots for washing the bottles, some of which, as every one knows, are very apt to lodge in the bottom, to become oxidated, and thus dissolved in the wine : and different wines of course experience different degrees of influence from three or four shots according as their acid qualities are in a more or less active state.

The dangerous adulterations of wine, too frequently observable at first sight, are mostly made after importation from its native soil, the trash used for the fabrication of Port wine being among the grossest of all. Sloe-juice is a prevailing constituent, which of itself is acrid, irritating, and in every way obnoxious to the stomach : and this perhaps is not the worst ingredient. The com-

mon prejudices in favour of Port wine are exceedingly mistaken. That it is generally a tonic, I deny; for no wine more readily promotes an acetous fermentation of the stomach, which fermentation communicates to the intestines that kind of impulse which causes flatulence and partial contractions; thereby favouring the undue lodgement of fæculent matter; and thus far, of course, its reputed astringent qualities are not to be denied. No wine, perhaps, is so much benefited by very long keeping as Port, for the reasons which have been stated: and I should not be disposed to regard it as suited to the use of delicate stomachs, until it has been kept at least ten years; but fourteen or fifteen would be still better. It is by no means to be regretted that Port wine is become unfashionable, and excluded from polite tables: and it would be well if chemistry and fashion went hand in hand for the rejection of more objectionable alimentary objects.

Ardent spirits, and in particular brandy, seem to be added with almost boundless liberty to sherry, thereby setting aside the advantage which it

would otherwise possess over other wines : for although the best sherry, when unadulterated, possesses some considerable portion of spirit, yet that portion is not sufficiently powerful to become objectionable when the wine is genuine and moderately aged ; under which circumstances it is less apt to promote morbid fermentation of the stomach than any other wine whatever : and I am satisfied, by repeated experiments, that a less quantity of alkaline or earthy matter is required to neutralize its acid in the stomach, than that of any other wine ; the acid quality of wine being often more mischievous than the spirituous, since the former will disorder a weak stomach more readily than the latter ; unless the latter be of undue proportion, or the wine drunk to excess. Next to sherry in this particular advantage, I am led by investigation to place Madeira ; and these are the most accessible wines of this country which I consider generally eligible for weak and flatulent organs of digestion.

A great variety of experiments on the other white wines, which it is not necessary to detail,

convince me that they are all, by far, more readily acidifiable. The rich wines of Malaga, and others of Spain and Portugal, besides some of Persia, are included in this remark; although they are now and then admissible under the advantages of due age and discriminate use.

Medicated wines were formerly in high estimation as stomachics and corroborants. Wine-bitters, as they are called, because a certain portion, scarcely a third, is commonly mixed with a glass of white wine, are still used with this view in the East and West Indies, particularly before dinner. They are in reality spirituous infusions of various vegetable bitters, and more or less resemble the compound tincture of gentian which is used in medicine.

The most elegant and most wholesome wine of the medicated class, is the Vermuti of Florence, and some other parts of Tuscany, which is really excellent according to the Italian recommendation, "*per consolare lo stomacho.*" Certain mild aromatics and bitters, of which sweet wormwood, whence its name, constitutes a small portion, are

infused ten days or a fortnight in a bland and saccharine white wine. If infused much longer, the flavour becomes too powerful. Under proper management, it is not only to be preferred for luncheon, but is even more eligible for breakfast than bad tea or bad coffee made with the unwholesome water which is but too common in Italy. The monks of St. Francis at Fiesoli are famous for the manufacture of this wine : and it is only in towns not very distant from Florence that it is at all genuine. In other parts of Italy Vermuti is a very different thing ; and the vulgar imitations of it which are exported from Marseilles under the same name, do not even resemble it.

The ordinary Florence wines of the table are extremely pleasant, clear to the palate, and inoffensive to the stomach : and though Aleatico and Chianti produced in the same district, are made more account of, they are by no means more grateful either on account of flavour or wholesome quality. These severally, are red wines ;

the grapes for which are allowed to ferment previous to their being pressed. Monte Alcino, a wine of the same country, is a vapourish sort of Champagne having a muscadine flavour; but very unfit for weak stomachs.

Of the wines produced in the environs of Naples, Lacryma Christi, whether red or white, is a pleasant and wholesome wine; having a mild bitter flavour derived from the volcanic soil which constitutes the vast plain of Campania; though the grapes preferred above all, are those cultivated in the more recent beds of *puzzolana*, or volcanic ashes at the foot of Mount Vesuvius, and especially at Pompeia, from which district they furnish the best still wine of Italy. If the Falernian wine of the classics was similar to that so called in Campania at this time, it was more appropriately an object for satire than a standard of excellence. The Falernian of the present day is of a rich purple, rather full body, somewhat the flavour of Lacryma Christi, but infinitely stronger, and readily affecting the head. St. Euphenia is

a wine of much the same general character. The island of Ischia produces wines of moderate body ; mild, saccharine, grateful, and inoffensive.

Of the Sicilian wines, more particularly so distinguished, that commonly known as Marsala, may probably be classed first in point of fitness for delicate stomachs. When of good quality and moderate age, it is certainly one of the most eligible white wines of the table. Syracuse is a pallid sweet wine approaching that of Frontignan, but altogether inferior to it.

The various modifications of Burgundy and of claret are among the most harmless of wines, provided they have the advantage of moderate age and favourable vintage : but in France, where they are the ordinary beverage of the table, they are used, by far, too early. Hence it is that their effects are so often complained of by the English traveller, and certainly not without reason ; since in this state they are apt to disorder the most healthy stomachs ; while, under proper circumstances, they are so far preferable to the wines in more general use in this country, that it is much

to be regretted they are not rendered more easy of access to the middle classes of society.

Among others of the continental wines eligible for the table may be named Bourdeaux, both red and white, Grave, Santerne, Moselle, with many more of the *rassis* and *reposé* kind: and as accompaniments of a nutritious diet, the muscadines of Lunel and Frontignan, both of which, in this point of view, are preferable to the extravagant Tokay of Hungary.

The wines of Champagne are not suited to habits that are disposed to flatulence: and the successful imitations of them which are made from unripe gooseberries are still more objectionable, not only on the same occasion, but from their still more readily affecting the head. Of the brisk sparkling wines, perhaps that of Asti in Piedmont is the very best.

Wines made from currants, raspberries, and other English fruits, very materially weaken the tone of the stomach, inducing a languid fermentation, with general torpor, flatulence, and depression of animal spirits, particularly with persons

who use but little bodily exercise. Elder wine does not so readily ferment in the stomach, because it is commonly used hot; but it is considerably narcotic, and its effects on the head do not readily pass off. The domestic *vin cuit* of France is made from the newly expressed juice of the grape submitted to a moderate heat until it acquires a rich body: and is used by way of *sou-lagement*, much in the same way as elder wine is used in England. Cowslip wine is perhaps among the most inoffensive of the home-made wines; but its use should be very limited. Mead readily promotes acid, with a troublesome sense of internal fulness and distention. In short, all the common domestic English wines are calculated to derange the alimentary organs at large.

Cyder and perry, having more mucilage, do not intoxicate so soon as wine; but they are injurious to weak stomachs, by the distention they readily occasion, and the flushings and feverishness which follow, their sugar and mucilage inducing acetous fermentation. Perry however is,

in general points of view, far more harmless than cyder. The very alarming affections of the stomach and bowels, which arise from an imprudent use of the newly expressed juice of the apple, and which are not unfrequent during the cyder-making season, in various parts of England, resemble closely those which are occasioned by the fumes of lead in smelting-houses. If lead be concerned in any part of the apparatus employed in the process of cyder-making, the malic acid is sufficient to decompose readily a portion of the lead, and form with it a noxious combination. In fine, the volatile matter of decomposed lead is apt to affect house-painters in a similar manner; and the disease is accordingly known as the *painter's colic*. In either case, it is dangerous to life.

Beer is the most powerful of the malt liquors, because it is not used until the saccharine matter, with which the malt abounds, has undergone a complete vinous fermentation; while ale, besides having a less proportion of malt and hops, is used when fresh, and before it can have acquired a strong vinous spirit. It is therefore refreshing

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in moderation, without readily intoxicating; and in a genuine state, is the wholesomest of all fermented drinks. Table beer is, in general, a mere infusion of the refuse grain, after its sugar and mucilage have been nearly abstracted to make ale. It soon becomes vapid, after a slight fermentation; and is in every state unsuited to weak stomachs. Porter cannot be used with impunity where the tone of the stomach is not the most vigorous, and, when adulterated, seriously affects the head, from the narcotic matters which are commonly used in the manufacture of it.

The cause of intoxication is the same in all fermented liquors, namely, a vinous spirit, and this is more or less energetic, according to the nature of the fruit or grain from which it has been produced, the manner in which the process of fermentation has been conducted, and the time allowed for its gaining strength. The acidifying qualities of fermented liquors are proportioned to the quantity, and the state of the sugar and mucilage which exist in them, and are considerably

modified by the constitutional tone as well as the contents of the stomach. Their frothing and sparkling qualities are proportioned to the combination of carbonic acid gas, which has resulted from the process of fermentation.

CHAPTER XX.

GENERAL REMARKS ON THE QUALITIES AND EFFECTS OF FOOD AND OTHER ALIMENTARY OBJECTS.

ANTIPHANES of Delos referred the generality of human diseases to the variety of food which luxury had adopted even in his distant days. In the present age also, it is undoubtedly a frequent cause of disease where prudence is disregarded : but besides the disadvantages of indulging in heterogeneous varieties, the very objects of food are rendered unsuitable to health by the innovations of modern management : and, whoever pauses to consider how unfit for aliment animals and vegetables are rendered when forced into a gigantic bulk by excess of gross nutriment, may possibly think it time that rewards and honours should be offered for restricting the breed and culture of each species to the salutary bounds which nature has prescribed in wisdom greater than man can

ever attain. The legs of animals and the stems of vegetables are, by excess of nutriment, alike rendered insufficient for their support; and the very means adopted for this unnatural enlargement render them also chemically objectionable. The animals are loaded with a most disgusting and unsightly proportion of fat, which, besides making them unhealthy and a burden to themselves, causes their flesh to become flaccid, and accordingly less fit for our use; the acid concrete oil, which we call fat, being particularly calculated to disorder the stomach. Meats acquire additional acidifying qualities from having been fattened with oil-cake; and when the flesh is marbled with fat, according to the language of the agriculturist, its alkaliescent qualities, which would otherwise counteract the acidifying effects of a moderate proportion of fat, are altogether set aside. Animals of fine close fibre are far more eligible for food than those of loose and coarse fibre. Every one who has attended to the circumstance, must be aware of these differences between a Cheviot sheep and a South Down; a sheep of the Romney Marsh breed

and one of the true Welsh breed. Soil has a material influence on the alimentary qualities of herbage, and the flesh of animals is influenced also according to the peculiarities of that they feed on. The beef of an ox, for example, which has fed on the produce of such fine soils as are common above the various modifications of basalt and of gray limestone, is more easy of digestion than that of one which has fed above chalk. In marshy districts, the qualities of the soil are sometimes evinced by saline concretions around the reeds and grasses which grow in them; and the roughness of grasses is referable to the presence of flint. In like manner, the wholesomeness of fish is influenced according to the peculiar nature of the beds of rivers, as they are gravelly or otherwise; and those which live in such water as is impregnated with impurities of various descriptions are apt to disorder delicate stomachs.

The flesh of wild rabbits is more digestible than that of tame ones. Confined life to an animal naturally wild renders it unhealthy; to say nothing of the difference of its food; for, supposing the

food to imitate that which the animal seeks by instinct, it must possess properties less salutary after it has been long gathered, than those of the herbage which is received into the stomach fresh from the soil. The flesh of the hare is very different from that of the rabbit. It is of considerably alkalescent quality, and, contrary to that of animals in general, best fitted for digestion while very young. Feathered game is much better for weak stomachs than any of our domesticated birds. The indigestible and acidifying qualities of the flesh of young animals in general, have already been adverted to in speaking of nightmare. Veal, therefore, should never be used by the subjects of bad digestion. By such, also, fish requires to be used with caution; and I conceive the prejudice in favour of its fitness for the sick, is just as mistaken as that in favour of eggs. It is never eaten without butter; and butter in every state and shape, independently of the peculiar oily acidifying qualities of the fish itself, is a most active promoter of nausea, heart-burn, and indigestion.

All the varieties of the cabbage tribe greedily

absorb the grossest constituents of the soil they grow in : and these literally become a part of their substance. The common practice, therefore, of feeding them with an excess of manure diminishes their wholesomeness accordingly. Asparagus, too, which is especially overcharged with manure, if not used at a time when its juices are aqueous, would be highly objectionable ; as is sufficiently evident in the fœtor it communicates to the urine. Sea-kale, from the far more diluted state of its juices after blanching, is infinitely preferable for delicate stomachs. Blanching not only improves the fitness of some vegetables for aliment, but is absolutely necessary to render the use of others safe. Endive, for example, would be irritating without this process ; celery, a decided poison ; and it has even a disposition to excite a modification of erysipelas when not sufficiently blanched.

Very erroneous ideas are commonly entertained as to the cooling and aperient qualities of vegetables ; and cold salads and crude fruits, such as apples, are often eaten freely, under an impression of proving beneficial by acting in that way : while

in an enfeebled state of the stomach they are incapable of assimilating with its contents and secretions, remaining undigested for a considerable length of time, and frequently causing a spasmodic action which extends itself to the intestines through a great part of their course; whereby they are caused to contract partially, to become distended with flatus, and to retain portions of excrement unduly. Thus the very reverse effect of that desired is produced. The use of raw vegetables and fruits is always objectionable, where digestion is not unusually strong. Foremost in the mischievous way are melons and cucumbers. While the seasonings, which are commonly used with the former, have little advantage in qualifying their turbulent effects, those resorted to for the latter are still less efficacious, particularly when the rind is removed; and as that possesses a bitter stimulus, it seems ordained by nature for aiding the digestive powers, and enables certain persons to eat cucumbers in the rind with perfect impunity, while they uniformly suffer for eating them without it. Cucumbers stewed in a plain way are not

only harmless, but perfectly wholesome. The endless variety of gourds are seldom presented at table without having undergone some culinary preparation. Inert, insipid, and in no degree nutritive of themselves, their pulp constitutes a mere sponge for containing various gross and objectionable compositions of butter, rich gravy, and other generators of acidity of the stomach and viscosity of the blood, in the same manner as artichokes furnish the lovers of butter with an excuse for eating it. Turnips are rather apt to create inconvenience in flatulent habits, although in a general way they are among the most eligible of our common vegetables. Carrots, if not used while very young, require to be made almost a pulp for stomachs which are not the strongest: under these precautions they are very excellent, as are also parsneps. Potatoes seem only objectionable while they are close and watery, or not sufficiently dressed.

Of the common seasonings of the table, salt is to be considered as moderately stimulating and aperient: but people in general seem to forget the

different effects of using salt as a seasoning, and eating salted meats. The latter abundantly promote thirst and indigestion, while the former, on the contrary, assists digestion materially. Mustard, Cayenne and the common peppers are very fit stimulants for general use. It is not from the influence of these that the seasoned dishes so designated are objectionable; but from the grossness and viscosity of the gravies which are concerned in them: and it often happens that more stimulating nutriment is contained in an ordinary quantity of soup eaten at a meal, than in as much solid meat as would satisfy a good appetite. Soups add to the viscosity of the blood, which is already of languid circulation where the powers of digestion are infirm; rendering the action of the heart laborious, and favouring a determination of blood to the head, with all its grievous consequences. Animal jellies should be cautiously used on the same account, although they are infinitely more inert. Broths are very apt to promote flatulence and acidity, particularly when made from veal and chicken: and on many occasions a moderate

portion of solid food, such as mutton, may be eaten with far less inconvenience to the alimentary organs when they demand regulation.

Spices require to be used with caution for delicate stomachs; and of all others, nutmeg, mace, and cloves, should be avoided. They abound with heating essential oil, and an over-powerful aroma. Ginger is unquestionably the wholesomest; and cinnamon may with due reserve be classed next to it.

The farinaceous grains are excellent in most of their usual preparations, except pastry; and admit of many agreeable varieties. Bread is commonly used too largely. The object of submitting it to fermentation is to destroy its viscosity; but this quality is not overcome by the ordinary process of baking; and hence new bread is extremely viscid, and unsuited to any nutritive office. Nothing more readily disorders the alimentary organs at large, or more readily promotes eruptions of the face. An inordinate use of bread, even after it has been kept sufficiently, is sure to obstruct the bowels, and vitiate their secretions.

It is very frequently imagined that fresh fruits may assist the action of the bowels ; but discrimination is requisite both in the kind and in the time of eating them. Even the most eligible should not be eaten immediately after dinner by those who are subject to bad digestion. Perhaps the best time is between breakfast and dinner, when they should be accompanied with a dry biscuit, which materially obviates acid fermentation. Strawberries, raspberries, gooseberries, and currants are among the preferable. Grapes are very apt to promote acid. Apples and pears should never be used raw, where the powers of digestion are feeble. They only serve to promote crudities, flatulence, and contraction of the intestines. If fruits abounding with hard seeds, such as currants, be used too freely, they may occasion mechanical obstruction of the alimentary canal, by collecting in masses detached from their pulp. Cherries and plums are unsuited to weak stomachs in every shape. They produce a sense of weight, coldness, and fermentation. Above all, damsons are objectionable in this respect, and are

further apt to promote the accession of erysipelas, in habits which are prone to the disease, from the quantity of prussic acid which they contain. Their bad effects are moreover aggravated by the indigestible qualities of the pastry with which they are usually accompanied. Of the mischievous qualities of nuts in general, every one is aware; and these like almonds, whether blanched or not blanched, are ready promoters of erysipelas, from the acrimonious influence of their essential oils. Peaches, also, are often apt to disorder weak stomachs very severely from the presence of prussic acid; but it is worthy of remark, that individuals who experience no bad effects from eating them immediately after they are gathered, suffer great inconvenience from eating them after they have been gathered one or two days. It appears that an acid fermentation takes place in the fruit during this interval, by which the noxious qualities of the prussic acid are called more particularly into action. The wild varieties of the peach which besides many of the more saccharine sorts, grow amongst the ordinary forest trees on some

parts of the banks of the Ohio, and many of those which grow in orchards in America, are only considered food for hogs in that country; and the animals are accordingly fed on them. The pungent and stimulating food which their stomachs are capable of bearing, is instanced in this country in their feeding on acorns, which are heating and difficult of digestion: and badly ripened peaches, or other acrid fruits are only fit for hogs in any country. Nectarines, containing more sugar than peaches, do not so rapidly go into a state of acetous fermentation, and are therefore more harmless.

There is an analogy between cold and acid, which is observable in many phenomena: and it is remarkable that obstinate acidity of the stomach is often overpowered by eating water ices. Cream ices do not so readily exercise this quality, for the obvious reason, that cream itself is very apt to become acid as soon as it enters the stomach; and its temperature is not quite so low; but water ices used with precaution, are occasionally very excellent medicines. The carbonic

acid and low temperature of cyder have also the property, in many cases, of overcoming the less powerful acid of the watery contents of the stomach.

People are very apt to talk in a vague and inconsiderate way about the ill effects of tea, as if various causes may not influence its qualities in common with those of all the other vegetable matters we are in the habit of using. When the tea plant is very young, its juices are acrid, stimulating and diffusible of their influence on the nervous system, in the same way as very young peach-leaves are poisonous. Hence it is that green tea is unsuited to weak habits, and that it is so apt to prevent sleep. Bohea and the common souchongs are not only of a different variety of the shrub; but they are, in a great measure, the mere gleanings of leaves which have passed the period of their perfection; and when, like the general withered leaves of autumn, they are nearly dismissed from the service of nature, as unable to contribute to the offices of the vegetable economy. These teas serve only to promote a sense of

nausea and emptiness, languor in the morning, and disturbed rest at night. But the best kinds of souchong, as they are called, and which are derived from the plant at the exact period of its maturity, possess no sort of mischievous qualities.

On the contrary, they are in a certain degree tonic, if used in moderation, and are wholesome diluents of our more firm and gelatinous aliment. Much of its effects depends on the preparation of tea for use ; since the best kinds badly prepared may exert qualities as noxious as the worst : and it often happens that the water, either on account of the soil over which it has passed, its impregnation with noxious vapours, or the nature of the pipes through which it is conveyed, is often more in fault than the harmless dried leaves which are so idly abused. The free use of sugar, too, often brings tea into disrepute, when the sugar alone is in fault ; since nothing more readily promotes acidity of the stomach, head-ach, and languor.

The Chinese communicate a great variety of flavours to tea by a very simple art ; which, however, in no degree renders it more wor-

thy of preference. Numbers of children are employed in their establishments to touch each leaf, as the plate of dried leaves is removed from the oven, with a camel hair pencil dipped in spirituous solutions of resinous and aromatic gums, or, in other words, various kinds of varnish. The cowslip souchong, to name a single example, receives its peculiar flavour from a process of this kind: and from the cheapness of labour where the population is so vast, it is rendered at as low a price in the market as the unsophisticated tea of the same original quality. All these artificially flavoured teas serve to weaken the stomach; and exercise some degree of narcotic influence. Very elegant flavours are sometimes communicated to teas by a combination of the blossom-buds; and these are quite harmless.

Coffee is more generally apt to promote thirst, and confinement of the bowels, than tea. It is a sort of opiate, which stimulates for a short time, but afterwards occasions exhaustion. As an opiate however, it may now and then be used in the morning with advantage to palliate the tor-

ments of nervous irritability on the stomach and intestines; but the subjects of such infirmities should be cautious of its general use. Chocolate and cocoa, like milk, are too heavy for the generality of weak stomachs, in which milk is also prone to coagulate, and create acidity. It is chiefly from the acid tendency of milk, that suckling animals are unsuited to delicate powers of digestion: for, as their flesh must necessarily be influenced by their food (veal, for instance), instead of forming a wholesome pulp in the stomach, it forms only a mass of acid crudities, the transmission of which through the alimentary canal is, probably, only assisted by the mechanical division which it first receives from the teeth: and I am confident that, in many instances, the salivary fluid serves to coagulate its albumen and concrete its oil, rather than to solve it into a pulp.

It is from the indiscriminate or licentious use of particular kinds of aliment, that prejudice against them is so commonly established. Where discrimination is exercised, there are periods at

which even food not easy of digestion, may prove beneficial by the communication of a mechanical stimulus : and it is probably from the observation of a casual occurrence of this kind, that a vulgar opinion has prevailed, that cheese assists the process of digestion : whereas, in a general way, it deranges the function most seriously. There are periods, too, when fermented liquors, with proper precaution, may exert a beneficial influence : but out of the great mass of mankind, to how few may this be acknowledged without an apprehension of danger !

CHAPTER XXI.

OF CERTAIN CONSEQUENCES WHICH RESULT
FROM A DISORDERED STATE OF THE ALI-
MENTARY CANAL—OF GOUT—OF ERYSIPE-
LAS OR ST. ANTHONY'S FIRE.

A LOSS of appetite may be regarded, generally, as a beneficial instinct, which nature seems to have ordained for obviating the accession of such matters to the stomach, as it has not the power to assimilate with the common mass of nutritive fluids, under that diminution of vital energy which is occasioned by disease; at which time, therefore, it is unwise to force the appetite; for, by so doing, new difficulties are opposed to the struggles of the animal functions.

A certain degree of abstinence is far more essential to health in persons who are advanced in life, than in the young and active: for at this time, less exercise being taken, because the mechanical powers of the system are not so energetic, and

less vigour of mind being exerted, because the sensorial powers are more torpid, elderly people are apt to indulge in the pleasures of the table; by which they are adding daily to the weight of their infirmities. Stimulating food and fermented liquors promote the morbid deposition of earthy and saline matters in the secerning glands; and above all, from the kidneys to the urinary bladder. Exercise being taken in a very inadequate degree to that which nature requires for the assistance of her general functions; affections of the head, pains in the loins, and disordered appearances and inconveniences of the urine, are perpetually complained of. Excrementitious substances are retained in the alimentary canal; and in all the stages of life, as long as this is the case, the whole system becomes languid; a general lassitude prevails, and the bodily strength daily becomes more enfeebled.

Under these feelings, objections are made to the use of active purgatives, from an idea of their weakening the system: while in reality, the accumulations, which can be relieved by no other

means, are the cause of weakness to the whole frame: and as soon as they are duly removed, the bodily strength revives. These disordered accumulations are foremost of the causes of depressing passions.

Persons who give way to despondency, shun variety of scene and variety of circumstance; and thus the distaste of exercise increases in proportion as the torpor of the mind increases. Acidity of the stomach is one of the earliest inconveniences; and it commonly causes a greater desire for animal food than for any other kind, because its alkaliescent tendency for a moment seems to relieve the inconvenience: but a torpor of all the alimentary organs soon becomes established, and the use of fermented liquors, in addition to that of improper food, serves only to provoke flatulent distention, and an additional incapacity of the digestive powers. These inconveniences have probably induced persons subject to them to try repeated doses of salts, or magnesia, or some simple domestic aperient, which in nine instances out of ten afford no sort of benefit, because they have

only operated partially, and exerted no influence whatever on the detained excrement. It is imagined that no fault can remain internally, because each successive dose of the domestic remedy has produced watery evacuations: and watery evacuations may be excited for weeks and months in succession; and still the offending cause remain; since inefficient doses of saline and other purgatives exhaust their influence on the early part of the intestinal canal, and pass by the excrement detained in the cells of the colon without exerting any action on it. They are deprived of their medicinal qualities before they reach the large intestines. This circumstance alone shows the impropriety of persons trifling in such a manner with their health, since regard should be had to the species and combination of those purgatives, which are suited to the particular age, habit, and other circumstances of the patient, and the duration of his malady.

In just as eminent a degree, as depressing passions promote this kind of internal mischief, does the circumstance of neglecting to promote a free

daily action of the intestinal canal, create despondency. All the particular circumstances which have been enumerated with respect to the alimentary organs, are fully established ; and melancholy often runs on to active madness. The circulation is laboured, the tongue furred, the countenance dejected, the eye turgid and coloured with bile, the skin partakes of the same tinge, the face is beset with eruptions which are hard under the skin, the rest is broken, the sleep attended by startings, and haunted by distressing dreams. The urine is passed frequently and without colour ; sometimes it deposits a sediment. The patient in the very lap of comfort, feels the storm of adversity thickening around him : he mistrusts his confidential friends ; and, while he shuns their presence, dislikes to be alone. By judicious treatment, all these frightful circumstances are often dispelled in a few hours ; frequently in a few days : and but few weeks are required for the restoration of the accustomed health, and animal spirits.

So many circumstances of age, constitution,

season and climate require consideration, for determining the kind, the quality, and the repetition of purgative medicines, that it would be difficult to enumerate the whole with perspicuity. Innovation has attached a preference to mineral aperients and alteratives, greater, perhaps, than is altogether prudent in numerous instances : and by this kind of prejudice, the vegetable department of the *materia medica* has been rendered far less conspicuous than heretofore, to the advancement of mere caprice rather than solid advantage. As the vegetable kingdom is considerably resorted to for such of its productions as are known to maintain health, so likewise should it be visited for those which are known to relieve in sickness. In a general way, I only approve of mineral purgatives and mineral medicines, especially the metallic, when they are either combined with or followed by those of a vegetable nature. Whoever explores the recondite treasures of distant times, will find that the medicinal remedies of the vegetable kingdom were advanced to the good of mankind, by the deliberation of wisdom, and the

evidence of experience : and that man was proverbially wise who knew plants, “ from the cedar of Lebanon to the hyssop that groweth out of the wall.”

The class of purgatives are of more importance to the healing art, than all the numerous objects of the *materia medica* besides ; since they are in a limited way essential to our existence. As an hypothesis in support of the absolute necessity of attending to the state of the alimentary canal, I would submit that as a river or aqueduct into which heterogeneous matter is continually thrown, becomes more or less impregnated therewith in its body, and which impure combination is gradually deposited upon the weeds and pebbles of its bed, since they furnish convenient surfaces for attracting the more slimy parts of it ; in like manner, whilst any mass of fancied nutriment, which is destined to pass through a torpid alimentary canal, pursues its course, a slimy deposit takes place on the internal surface of the intestines, which the offices of their discerning vessels have not the power to remove, by reason of the in-

adequate quantity of watery fluid usually supplied: for although it may be concluded that nature in her beneficence has provided duly for this supply in health, yet it is to be remembered, that the torpor of the alimentary system, induced by modern habits of life, the unnatural and adulterated state of innumerable articles of food supplied by the avaricious class of mankind, and the groveling ignorance of cooks in devising compounds, of which one would suppose the sole object was to disseminate disease and infirmity, render the ordinary provisions of nature insufficient for the well-being of the system, and the discharge of its ordinary functions. The wholesome streamlet is rarely in want of assistance; and so it is with the intestinal passages of those who, living in the open country, pursuing healthful avocations, and contenting themselves with simple food, offer no outrage to nature, and accordingly find that her provisions are generally adequate to their necessities.

Gout is such a common consequence of inordinate eating and drinking, that any illustrations

of the fact are unnecessary. It is altogether a disease of the stomach at whatever period of life it may occur; and in whatever habit of body. That besides the luxurious and plethoric, modifications of gout sometimes affect persons of spare habit both in youth and after the meridian of life is certain: and such persons, it will be found, are not sufficiently habituated to bodily exercise; and are moreover either inattentive to the offices of the alimentary canal, and to general objects of diet; or are constitutionally subject to extreme acidity of the stomach.

Among the remedies which have been suggested for the relief of gout, that of cold affusion is not the happiest; and requires great discrimination in its adoption, especially with respect to age. The sudden expulsion of inflammation from the foot is known to produce spasmodic affections of the stomach, and not unfrequently to determine a flow of blood to the head, which if not immediately fatal shortly becomes so. I am led, by considerable reflection and observation, to believe that in plethoric or even moderately full

habits, repelling gout by cold affusion from the extreme parts of the body may be resorted to with some safety, only in early life; and at latest, not after thirty, nor even then when the habit is particularly full; conceiving that the efforts of nature may, with less expense to the animal economy, be suffered to effect relief: since it commonly appears that when these are opposed in one particular situation, they are immediately directed to another infinitely less calculated to resist the power of inflammatory action.

Gouty subjects are especially afflicted with accretions of an earthy nature, such as have frequently been adverted to in the foregoing considerations, as influenced by indiscriminate feeding. Ossifications of the blood-vessels are another consequence of this morbid secretion of calcareous matter; by which means they lose that elasticity which is essential to propelling the blood duly through its course. These partial conversions of blood-vessels into bone are most apt to occur at or near the great centre of the circulating system, the heart: and where the

carotid arteries have been ossified, I have found all their ramifications belonging to the brain, most unusually distinct in their extremest branches.

Erysipelas is another of the most conspicuous consequences of indiscriminate and inordinate eating. To enumerate the many objects of aliment, and the peculiarities of constitution which favour its accession, would be endless ; since the disease varies exceedingly in its external characters. In the better classes of society, however, no kind of food is so apt to excite the disease as fish of all descriptions, especially any kind which, according to common language, is " out of season ;" and this circumstance ought to meet due attention in every well regulated house ; for it is certain that the economy of all the watery tribe experiences periodical changes of a chemical nature, which according to various irritating qualities, whether from the influence of animal oil, or of metallic salts, render them less fit for our aliment : and I believe the degree of offensive quality to diminish as the scale ascends from the *Mölluscæ* to the larger and more esteemed fishes of our

tables. The poisonous irritation of the skin occasioned by many of the molluscæ, for example, certain kinds of star-fish and blubber, is familiar to every one; and in England we never think of eating them: yet the Greeks and Romans, by many evidences of classical tradition, esteemed some of them as luxuries; and to this day, we find the cuttle-fish (*sepia officinalis*) a common dish in Naples, and on many parts of the Mediterranean shores. It does not appear what polypes were most esteemed among the ancients. In the lower classes of life erysipelas, in its severest forms, is very commonly occasioned by a stimulating and nutritious diet after continued meagre and unwholesome living.

Erysipelas seems to be the effect of diminished arterial power, whether it presents itself in a debilitated or a robust habit. In the former instance, it may result from what has been called a loss of tone in the system; in the latter, from a rigidity of fibre. In either instance, the blood is not duly propelled through the extreme vessels: yet the average cases of erysipelas which

require the exhibition of stimulants, are very few in comparison with those which yield to extreme depletion. The former treatment is perhaps only eligible where mortification is threatened; when the parts are cold, and the blood has a livid colour. The effusion which commonly attends a favourable termination of inflammatory action, as perspiration, abscess, or secretions from the glands, is sufficient to show that a yielding of the soft solids is necessary to the event: and these effusions are principally directed to the surface of the body. In a general way, it is of the utmost importance to consider collateral diseases, peculiarities of constitution, and local circumstances. The patient who has been long resident in a large and crowded city cannot with prudence be treated with such active remedies, as he who has led a life of activity in the country.

Children suffer various modifications of erysipelas from being pampered: and in idleness, they are led to eat the peelings of white-washed walls, bits of mud wall, chalk, and other earthy matters, in the same way as females under the

influence of sexual complaints sometimes experience similar propensities. In either instance, acidity of the stomach causes the desire for those neutralizing agents, although the individuals may not be aware of its nature. In like manner, when birds have an insufficient supply of earthy matter to the blood, for the completion of their eggs, they are perpetually pecking at the mortar of walls, and will even eat broken egg-shells, as already instanced, if they come within their reach. Thus the admirable simplicity of nature often prescribes a remedy which the patient does not suspect.

CHAPTER XXII.

OF ATMOSPHERIC TEMPERATURE, LOCAL STATION, AND CERTAIN HABITS OF LIFE—OF SCROFULA.

THE influence of climate and local station on the alimentary organs is not only conspicuously observable under distant and different degrees of latitude, but the changes induced by atmospheric phenomena alone, upon various functions of the animal economy, intrude themselves on the notice of every one, without any change of station or worldly avocation. If the views of our physical structure which I have attempted to set forth (in Chapters IV. and V.) be duly borne in mind, it will not be difficult to conceive how readily the animal machine may become affected by changes of atmospheric temperature, or how effectually impregnated by contagious vapours. As, however, atmospheric influence on the alimentary organs is more especially my object, the latter consideration must not detain us in this place; and although caprice and prejudice have uplifted their

voices against the doctrine, I hold it just as reasonable to deny that the lungs are of any importance to the office of respiration, as that the air of the atmosphere does not influence the state and condition of the whole animal economy ; and this not only by acting on superficial surfaces, or by inhalation on the lungs ; but equally if not more powerfully, by being received into the stomach. The warmest clothing is not sufficient to obviate the tormenting effects of severely cold air upon the stomachs and intestines of delicate individuals. If we admit that the atmosphere exerts an influence physically, we must also admit that it exerts no less an influence morally ; since it is unquestionable, that the mind is in a great measure governed by the state of the stomach and intestines.

Intensely cold weather has the power of constricting the muscular and every other elastic apparatus of the whole frame. Accordingly, the bowels are considerably affected, and the evacuations less frequent than usual : they are indurated, and passed with some inconvenience : still, how-

ever, the liver seems to perform its duty ; for they are coloured with healthy bile, and acidity of the stomach does not generally prevail at the time. Nature, ever struggling against casual disadvantages, causes a more abundant secretion of urine ; which, in some measure, remedies the evil, although flatulence, head-ach, and some degree of light-headedness, commonly arise from the insufficient action of the bowels.

In the hottest weather of temperate climates, the alvine evacuations exhibit much the same appearance of costiveness, and are frequently passed with inconvenience ; but the increased perspiration which naturally occurs under such temperatures makes amends for a deficiency of relief from the action of the bowels ; and while the urine is not passed in an increased quantity, it is of a quality more efficient to the welfare of the system than on ordinary occasions. In like manner, during confinement to bed, while a copious perspiration goes on, comparatively little mischief results from a slowness of the bowels to act.

A humid atmosphere of mild temperature,

charged with penetrating vapour, and under an overcast sky, is the most troublesome to the hypochondriac: nay, I will venture to assert that it is to every person of delicate constitution no trifling annoyance. Relaxing the muscular fibre to an extreme degree, the pores of the skin are open to the accession of moist and chilling vapour, whereby rheumatic pains are felt, even in the substance of the bones; the surface of the lungs is materially affected; the stomach and intestines experience a sense of distention, of chilliness, and partial contraction; the evacuations are watery; the substantial parts of them exhibit decided casts of the cells of the intestines; and they are of a pale colour for want of a due admixture of bile. The stomach also becomes affected with acidity and heart-burn: and in very nervous subjects the *globus hystericus* is not unfrequently felt, from the influence of flatus. If either piles or relaxation of the lower intestine have heretofore distressed the patient, they are very apt to recur under the influence of this kind of weather. Persons, therefore, whose habits of life do not require

going abroad, should keep the house at such times ; and be very careful that their rooms and wearing apparel are well aired, although they should not indulge in sitting very near the fire. It is extraordinary how thoughtless many persons are with respect to the airing of rooms, who are scrupulously attentive to their general health. I believe the neglect of this circumstance to be nearly as mischievous to delicate constitutions, as the use of damp bed-linen and damp clothing. It is common in many houses for the eating-room fire to be lighted only ten minutes or a quarter of an hour before dinner time : and it would be much better if it were not lighted at all ; for the fire, just about this time, begins to attract the cold air with which the room is filled ; the stratum of air level with the fire is first drawn towards it, and by degrees stratum after stratum descends to feed the fire ; a process which occupies some considerable time : so that the family who have just come out of a warm sitting-room are under the full influence of damp vapours until it is time to leave the table. They then return to the warm room : and

the next transition is probably to bed-rooms without fires, which are filled with cold air, and to beds surrounded with damp hangings; yet both these evils are scarcely so great as that of the dining-room which has had fire just long enough to attract its cold vapours with all due force through every species of ordinary clothing. A moderately large room, which has not a constant fire in it, cannot be properly aired in less than three or four hours, nor a bed-room in less than two hours. Bed-room fires are of still more importance in large cities than in the country. In short, they are in those situations the only substitutes for pure air. A fire serves more to benefit the room in a large city, than all the air which can be admitted at the windows during the winter months. People wonder that they are troubled with coughs by night, whilst they have none by day. The cold and damp air of a bed-room without fire more than sufficiently explains the reason: and nurseries should on no account be without fires at night, where children have delicate health: particularly if they be sent to bed at a time when

they are in an active perspiration from exercise ; a circumstance which generally does not meet proper attention. Children are, perhaps, more frequently subjected to the ravages of cold by the imprudence of their parents, than any of their own ; and especially by that fashionable species of insanity, in adopting a degree of nudity even more than sufficient to become the active generator of pulmonary consumption, and all the ghastly characteristics and appalling sufferings of scrofula. I have already stated, that it is a mistake altogether that scrofula is necessarily an hereditary disease. Every form of scrofula, from moderation to extreme virulence, may be induced by improper food, improper clothing, and unwholesome air. People are shocked and distressed beyond measure at the sound of the word scrofula ; and certainly not without cause : but they are not ashamed to talk of their children being affected with rickets, or of their having died of atrophy, both of which are but softer terms for two grievous forms of scrofula. Examinations after death demonstrate effects which can correctly be referred to no other

disease, however ingeniously the appellations may be contorted or softened down.

It is a common mistake that fat children, with florid complexions, are of healthy habit. From such appearances, parents are led to neglect the state of their general health, until disease has so far established itself as to be beyond the reach of the healing art. A scrofulous child of full habit and florid complexion, in some instances, goes on for two, three, or more years, without evincing any symptoms of disease to persons of common observation; and even without suffering the usual inconveniences in cutting its teeth. Accordingly, the appearance of its evacuations is never thought of; and although the belly be tense and prominent, the eye glairy like that of a fish, the margins of the eye-lids of a pale coral colour, and the head considerably out of proportion, nothing is thought of it until the latent enemy becomes developed under a form too powerful to be subdued. The child, from this form of the disease, is brought more rapidly to its dissolution than one of a pallid and generally diseased aspect, who has, from

its birth, been under a continual medicinal regimen. Children of florid habits do not so soon evince swellings of the glands of the neck, or sores about the hands and feet, with ill-conditioned biles, which degenerate into considerable sores, as those of a more tabid and rickety character. The following appearances are not uncommonly presented on examining the remains of scrofulous children: and as the account holds good wherever the disease has rooted itself, it will serve to show how far the malady is beyond remedy; and remind parents, that although certain circumstances with regard to the management of health may appear trifling—respectively, they become formidable by accumulation.

The integuments of the belly are commonly thin from distention, the muscles flaccid, of a dull purple colour, and their fibres scarcely distinguishable: the whole peritoneum profusely covered with tubercles, mostly about the size of a compressed garden-pea, while many of a less size form considerable clusters: the omentum is sometimes lost altogether, the whole superficial surface

of the intestines adhering to the common peritoneal lining of the abdomen ; so that both surfaces constitute a confused mass of disease : a great part of the large intestines are thrown completely out of their natural station, to the middle and fore part of the abdomen. Besides tubercles, the whole intestinal canal exhibits throughout, adhesions constituted by coagulable lymph, filaments of which arrange themselves, after the manner of cobwebs, in various and uncertain directions throughout the abdominal cavity. The tract of intestines is distended with flatus, and contains a large quantity of acrid, yellowish, watery fluid, partially coagulated in a curd-like manner ; while the excrementitious substance is of a pale ash colour and slimy, emitting the foetor of sulphuretted hydrogen. Every trace of muscular fibre throughout the intestinal canal disappears : the glands of the mesentery are much enlarged, and of a dull blue colour. The stomach is internally of a healthy appearance ; but externally tuberculated like the intestines : the left lobe of the liver compressed to the thickness of scarcely an inch, its upper surface adhering throughout to the diaphragm, the

right lobe resting almost perpendicularly by uniform adhesion to the back part of the abdominal cavity, its ligaments scarcely to be traced: the common structure not much altered, but the blood-vessels greatly distended: the internal membrane of the gall-bladder glairy, and of a bright gold colour; the bile contained in it, pale and limpid. Of the pancreas, not a vestige can sometimes be traced, while the spleen is much enlarged, and of a morbidly livid purple; its blood-vessels much distended; the kidneys often enlarged. Of the diaphragm scarcely a muscular fibre, perhaps, can be traced. Under these circumstances the muscles of the chest frequently appear florid; and while no watery fluid is observable in its cavity, the lungs show but trifling signs of disease: yet I have found the pericardium (the membrane covering the heart) thickened, and distended with watery fluid, sometimes containing hydatids. These I have also found in the heart itself: and there is no internal organ which has not exhibited them under particular forms of disease. Hydatids can scarcely be distinguished by any other characters than that of a membranous bladder, with

a mouth, the head being very imperfectly defined: they vary exceedingly in dimensions, from one, two, or more inches in diameter, to less than half an inch: they are commonly found in diseased fluids, sometimes solids, not only in the human subject, but in various animals. The mouth sometimes exhibits fangs, by which it is attached to the surface of the substance to which it adheres.

The ravages of scrofula seem more particularly directed to the alimentary organs than to any other internal or external parts of the body. In fine, I conceive that it is the disordered state of these alone which induces that unhealthy condition of the whole system, whereby the slightest external injuries constitute ill-conditioned sores; and all the more superficial glands are rendered susceptible of inflammatory attacks, on such trifling excitations as would affect no others than the subjects of scrofula. Cold from thin or damp clothing, and dirty skin from unclean clothing, are just as likely to promote this morbid condition of the contained organs of the belly, as any irregularities or severities of atmosphere: and although

the contained organs of the chest readily take on a diseased action, so as to establish decided pulmonary consumption, yet they are second to those of the belly in the order of their fatality : and third in this order I am disposed to place hydrocephalus, or watery head.

How commonly scrofula obtains in cold exposed situations, and in moist valleys ; and how especially the disease is apt to attack the glands of the neck and face, is familiar to every one : and I am satisfied, by observation, that the *goîtres* or *gouétres* of Switzerland arise from scrofulous affections. Laveaux derives the term from the Latin *guttur*, defining it—"Tumeur qui se développe entre la peau et la trachée-artère sur la partie extérieure du cou, par le gonflement de la glande thyroïde. Elle n'est accompagnée ni d'inflammation, ni de changement de couleur à la peau. Cette maladie est commune dans certaines contrées froides et humides, où les goîtres sont quelquefois d'un volume énorme." Of turgid necks from these diseased glands, enough are seen in Switzerland to excite both commiseration and disgust—dis-

gust, because the unfortunate subjects of them instead of attempting to conceal, take pains to expose and decorate them. The deformity evidently originated in disease, and remains conspicuous, partly by hereditary influence, together with the measures taken to encourage it through motives of superstition and caprice; and partly by the favourable circumstances of cold and mountainous countries to the multiform accessions of scrofula. It has been an object of remark from distant times: and Juvenal, in the admirable satire which he addresses to Calvinus, with the hope of reconciling him to a great pecuniary loss; after dwelling upon the moral operations of ill-directed minds, adverts to the impressions of corporeal deformity: among others, familiarly adducing this Alpine species.

“Quis tumidum guttur miratur in Alpibus? aut quis
In Meroe crasso majorem infante mamillam?”

The appellation of *crétin* seems to be derived from *crête de coq*, on account of the fancied resemblance of a “*goître pendant*” to the pendulous

part of a cock's comb; and for which kind, the idiots of Valais are most remarkable. The Valaisans, in particular, consider idiocy a mark of divine favour, as averting all propensity to commit sin: and those with *goîtres pendans* are held in the greatest possible veneration.

A particular complexion, contour of the features, and colour of the eyes and hair, have been very commonly enumerated by medical writers, as the especial characteristics of scrofula: and it must be admitted, that these circumstances constitute a very fair criterion in innumerable instances. Still, however, there is no particular complexion, no cast of countenance, no colour of the eyes and hair from the lightest to the very darkest, in which I have not seen the disease in a greater or less degree of preponderance. No causes provoke it more readily than confined or impure air, and unwholesome diet. Scrofulous children should be made to live upon the seashore, should be warmly clothed, wholesomely fed, and their alvine evacuations duly promoted. They should be within doors only to eat and to

sleep, as long as the weather is good : their diet requires especial regulation ; for it unfortunately happens, that the influence of the disease creates in them a propensity for dry salt meats and savoury dishes, neither of which they should be permitted even to see. In general their intellect is the most brilliant, and their manners the most interesting : but it is necessary to be careful that their studies are not commensurate with their abilities. Adults, suffering from the influence of scrofula, should repair to a warm climate, adopting a plain though nutritious diet, and promoting as far as possible regularity of the stomach and bowels. Both children and adults seem frequently benefited by chalybeates and mild alkalis : but warm clothing and free bodily exercise cannot be insisted on too much.

If diet, cleanliness, and regulation of the alvine evacuations do not meet due attention, climate will avail but little. I have observed just as great a proportion of scrofula, in all its shapes, and particularly amongst children, in the southern parts of Italy, as in Scotland, or in the more unhealthy

parts of England, or in the cabins of Ireland. In the northern parts of Italy, on the contrary, the disease is comparatively rare, because the lower classes of people being employed in agriculture and in manufactures, are active, cleanly, and well fed. In the state of Tuscany especially, the peasantry are among the finest and most healthy people of the whole world; while in the more southern districts, as the state of Rome, and a very great part of that of Naples, they are squalid, infirm, diseased, and miserable. "But in many parts of Latium," it may be said, "the pestilential exhalations of the volcanic campagna may influence the disease: and at Terracina," (the Anxur of old) where it obtrudes itself even upon fertile and flourishing borders of the sea-shore, "the Pontine marshes may have considerable influence." At Salerno, however, which is a more southern latitude, there is no volcanic campagna, no marshy district. This favourite residence of Tasso is beautifully situated on the slope of a mountain chain, towards a bay more expansive than that of Naples, with an inland country, even more fertile and

varied, and much better watered. Though once proudly conspicuous, and especially for its university, the school of medicine, which was the earliest in Europe, having emanated from the Arabs, it is now meanly inhabited, and a very nest of misery. Here poverty and filthiness set aside the advantages of locality and climate; and scrofula prevails to a degree that is truly appalling. If Salerno were restored, by the repairs and attentions which it justly merits, it may serve well to ease Naples in some degree of that crowd of climate hunters, which, superadded to an already crowded population, renders it often difficult to obtain decent accommodations at an enormous expense, or even such as are absolutely necessary for invalids; Salerno being only twenty-seven miles from Naples, and the road passing through one of the most fertile and picturesque tracts of all Italy.

The teeth furnish very considerable characteristics of scrofulous habits. Either they are badly formed as to their common outline, their surfaces

are corrugated and discoloured ; or, if they be well shapen individually, their enamel is very thin, and preternaturally white ; and the spaces between the teeth are unusually wide. It is a wise precaution to observe the teeth of nurses : for I should always question the fitness of a wet nurse with a bad set of teeth, however other circumstances may be in her favour.

While the effects resulting to bodily health, from extreme degrees of heat in the more southern, and of cold in the more northern climates, have met due attention, I cannot think that the variation of temperature under a given latitude, is, in general, sufficiently considered as influencing the animal economy. Cold braces and constricts the animal fibre ; warmth and moisture relax it : and thus, under the weight of a cold air, we are not so sensible of the electricity of the atmosphere as when it is light and moist. The sympathy between the skin and all the internal organs of the human body, but particularly those of digestion and nutrition, is sufficiently evident ;

and the physical influence of the seasons, individually, needs no comment. The bilious fever, which is a modification of typhus or putrid fever, is so designated because it is attended by great discharges of bilious matter, either from the stomach by vomiting, or by the intestinal canal. It is most apt to occur in Great Britain towards the close of autumn, either when intense cold suddenly succeeds warm weather, or when the air has long remained moist and relaxing. Marshy districts are especially favourable to it, both in this and warmer climates. In the latter it is more commonly fatal; and occurs mostly after continued rains, succeeded by sultry heat. Certain circumstances of season appear to favour the accession of tetanus in debilitated, or particularly nervous habits, and to modify the degree of its influence when established by any casual event, as surgical operations, bodily injuries, and violent fits of passion. The electric state of the atmosphere, in proportion as it is greater or less, acts upon the nervous system, which may be regarded as a cir-

culating system of electricity in the animal frame ; and different degrees of atmospheric electricity, which are not perceived by us, materially influence the general health.

An old prejudice has obtained extensively in this country, especially among the lower classes of people, in favour of blood-letting on the accession of spring and autumn. That the variations of atmospheric temperature at those seasons are the cause of very considerable inconveniences to the circulating system, is unquestionable ; but they are inconveniences which will commonly be found to arise from intestinal obstructions from the same cause. Wherefore it is more prudent to have recourse to purgative medicines for relief ; since, although a transient benefit may be experienced from the loss of blood, still the bowels are in want of assistance, and may be expected to give occasion to future inconveniences. Blood-letting is among the most important and beneficial media of depletion to the general system ; but, except in the most urgent cases, I should

certainly class it, in point of general benefit, second to purgative medicines.

The mischievous effects of fruits upon the alimentary organs, if inordinately eaten at the season in which they severally become plenty, were adverted to in a general way when speaking of fermented liquors. The inhabitants of warm climates frequently incur severe bilious attacks, from indulging too largely in oranges, limes, and other cooling fruits, as they are commonly styled : but when used with discrimination, oranges, lemons, and limes are invaluable for their antiseptic qualities ; on which account, also, a free supply of them is of the highest importance to the inhabitants of crowded cities. In this country, however, it seems we know nothing of the genuine flavour of an orange, because it is gathered unripe for importation, and long before the saccharine principal is sufficiently developed. They are seldom fit for use in England much before the month of March ; and even then, not a particle besides the juice should be used by persons of weak digestive powers, since under these cir-

cumstances, even the soft pulp is indigestible, and the juice itself goes into an acetous fermentation when used too largely.

A residence in large and crowded cities, particularly if accompanied by indiscrimination with respect to food, and inattention to personal and domestic cleanliness, disposes the human frame to that especial state which favours the accession of scorbutic disorders, fevers of a putrescent tendency, and decided scrofula; and although the particular contagion of the plague is not understood, its ravages, when once established, are rendered more extensive by such circumstances. The dreadful visitations which Marseilles, for example, has so many times experienced, were undoubtedly aggravated by the uncleanness of its inhabitants, the insufficient ventilation of the houses, the scanty supply of water to them, and the filthy state of the streets. Similar circumstances strike every visitor, in some of the French towns, to this day, where the police is not active in preventing the domestic refuse from being thrown into the streets, which it will be remem-

bered are often particularly narrow, while the houses are very high. These disadvantages are still more remarkable in many of the towns of Italy ; where also another may be adduced, which cannot be without its influence in adding to the impurities of local atmosphere ; namely, the disgusting and truly reprehensible practice of heaping together vast numbers of the dead, within the respective churches, which are so numerous in every Italian town. The offensive exhalations from many of the churches in Rome during hot weather are positively intolerable. Here, as in many other places, naked bodies (coffins not being thought of) are thrown in heaps one after another into a large vault, of which each church has perhaps five or six. The continual putrefaction of these interments exhales its noxious vapour, not only through certain openings, but through the very substance of the stones, mixing with the external air, and adding to its impurities. In Florence, however, which has at times experienced tremendous visitations of the plague, these monstrous practices were wisely prohibited by the

late duke Leopold ; and for the last thirty years, an excellent institution of that ruler has obtained, deserving universal imitation in large and populous cities, of a capacious burying-ground three miles distant from the town, to which all the dead are regularly conveyed at midnight. These upon the average are from six to twelve daily. Pisa has also its *campo santo* without the walls ; while that of Naples is one of the most remarkable in the world. A large even piece of ground is furnished with three hundred and sixty-five deep square excavations, each having an aperture closed with a moveable stone, to which in succession a lever is applied day after day, so that twelve months having elapsed before either is opened, and the substance of the whole field being a dry volcanic mass, the decomposed animal matter readily becomes absorbed : and no materially offensive odour is emitted, although the average interment is from twelve to eighteen or twenty daily. In Spain, a quantity of quick lime is furnished to the places of sepulture, with a view to hasten decomposition. It would be well if the

too common practice in England, of burying within churches, were every where prohibited: for it is undoubted that noxious effluvia are thereby promoted, which, although scarcely perceived by many persons, are capable of acting unfavourably on the stomach and intestines, as well as the lungs. *Æriform* exhalations are often insidiously active on those organs when unsuspected, because they are not particularly obtrusive: and in such a way those of coal gas, now so extensively used, are not the least considerable.

The immense population of London could not, upon the average, enjoy such a fair portion of health as it does, but from the circumstances of the great mass of buildings of that vast city occupying an inclined plane, the ebbing and flowing of the Thames, an abundant supply of water to every house, and the enforcement of cleansing the streets. The constant flux and reflux of rivers, where it happens, is of the highest benefit to populous manufacturing and commercial towns at large, especially when the soil they stand upon is not light or gravelly. Those parts of London

even, which occupy gravelly stations, are more eligible for residence, than those occupying parts of its dark and moist beds of clay, which abounds with sulphuretted iron. Such soils are always damp, and render the lower parts of houses proportionably so. There can be little doubt, that the site of our metropolis, previous to the more recent alterations which the face of the globe has experienced, was the bottom of a salt-water lake ; and under a climate very different from that in which we now live : for the London clay, as it is designated, besides possessing characteristics in itself, contains the remains of marine animals ; while at Highgate, and at Kew, the most unquestionable remains of many species of tropical animals, both of sea and of land, have been abundantly found. I was never so struck with the salubrious influence of a dry soil, as at Haarlem, which occupies a bed of sea-sand amidst the swampy level of Holland. While the greater part of the surrounding country presents very little variety either of native or of cultivated vegetables, the extraordinary luxuriance of the gardens at

Haarlem, the cheerful trees of its environs, the better health and animal spirits of its inhabitants, all demonstrate (for there is no other evidence whatever) that the sand is a convenient and salutary medium for absorbing the superabundant and otherwise unhealthy moisture of the climate, and of converting it to the service of vegetation, whereby its injurious influence on the human frame is greatly obviated, if not altogether prevented. The fruit trees in the gardens and their several fruits are more luxuriant, generally, than any I have seen in the British dominions, or in France. The flowers in the open borders are equally flourishing, and neither fruits nor flowers receive a single particle of manure. From this circumstance, too, the culinary vegetables are of infinitely more genuine flavour, and wholesome quality, than those which we are in the habit of manuring highly in this country, abundantly demonstrating the simplicity of vegetable nutrition by the ordinations of nature, and the inexpediency of overcharging gardens with rich manure. Com-

post is used at Haarlem for the more rare exotics of the conservatories only.

Should this be thought digression, I apologize for it; yet I would be understood as attempting to elucidate the influence of soil and of atmosphere on the general health; and especially its primordial regulators, the stomach and intestines. The phenomena of soil and climate go hand in hand, and admit of important as well as interesting medical and physiological speculation: but they are too generally neglected, like those primary instruments of the alimentary process, which remain to be considered; and which being essential to enunciation, in common with digestion, have claims on the attention of medical science. Though the *teeth* perform the very first step towards that digestion which our aliment requires, I have reserved my particular ideas concerning them to this period, with a hope of enhancing the attention which they justly merit as alimentary organs, independently of other attributes.

CHAPTER XXIII.

OF THE SALIVA, AND THE INFLUENCE IT IS CAPABLE OF EXERTING ON THE TEETH— CLASSIFICATION AND GENERAL DISTINC- TIONS OF THE TEETH.

HAVING attempted to show in what manner all the glandular secretions of the body may become disordered from the influence of the stomach and alimentary viscera, few observations remain to be offered on the physical qualities of the saliva, since those, as well as the glands provided by nature for its secretion, have already been considered.

The saliva may become vitiated, not only where the habits of the patient furnish more than sufficient cause to account for it, but from unfortunate peculiarities of constitution, which prudence and temperance are insufficient to avert. It may therefore be concluded, that this fluid is capable of exerting various kinds of morbid in-

fluence ; and on no objects more generally than the teeth. Modified altogether as to its chemical properties, by the state of the stomach, it must exert a corresponding influence upon the objects on which it is perpetually at liberty to act ; for in the same manner as the stones on the sea shore harbour weeds and slime from the ebbing and flowing of the tide, the teeth furnish attraction and lodgment for those particles of earthy matter, which the saliva holds in solution, and which also, in the form of vapour and of vitiated mucus, arise from the stomach and organs of deglutition, lodge upon the tongue, and are perpetually carried to the surfaces of the teeth by this more watery fluid. That acrimonious earthy matter, known by the name of tartar, is no other than a condensation of the vitiated coating of the tongue, which no person can be too careful to remove by scraping every morning and evening at least, and by washing the mouth plentifully with water after every meal ; but the wisest precaution is to prevent redundant accumulation, by observing a

temperate and wholesome diet, by due bodily exercise, and by occasionally assisting the action of the bowels with aperient medicines.

The dark coloured and ill conditioned matter which, in the course of fevers, spreads over the tongue, and encrusts the teeth in so short a space of time, evidently comes from the stomach, by the secreting surface of which it seems to be chiefly produced, its colour and character being modified by the admixture of matter from other sources, as disordered bile from the liver, disordered salivary fluid from the pancreas, and mucus from the secerning membrane of the first intestine, these respective organs having been demonstrated to be capable of transmitting their particular secretions to the stomach by the retrograde action of disease. Nothing tends more readily to promote the accretion of tartar, than the abuse of fermented liquors.

Disorders of the throat also, for example ulcers, have great influence on the saliva. In short, the causes which may influence an alteration of its healthful qualities are too numerous to be

adduced in the present instance. In adverting, however, to its effects upon the teeth; while it is remarked, that the second and third double teeth are generally the earliest to decay, it may be remembered, that the salivary duct terminates in the upper jaw very near them, and is capable of acting even more on the corresponding surfaces of those below.

To establish the cause of decay in the teeth, various theories have been formed, each having been contended for by its projector with a vehemence which naturally attaches to the idea of novelty, and a confidence which the nature of certain facts would appear to warrant: but cases are too numerous which invalidate the most plausible, and annihilate the most ingenious, showing the attentive observer, that the cause must be different in its origin, although its effects be similar.

The *pain* called tooth-ache, and which Galen very properly considered the most cruel and grievous of all pains that are not mortal, seems clearly to be occasioned by *decayed portions of*

bone, no matter how minute, acting by contact on *the nerves* of the teeth : and I firmly believe the pain is never felt until the caries, which always proceeds from without inwards, has actually met a branch of nerve.

No species of animal matter, in a state of decay, is so offensive to the vitality of the adjoining substance, whether nerve, or muscle, or membrane, or any part or portion of the living body, as decayed bone. How very small a portion of decayed bone in a tooth, is capable not only of causing the most agonizing pains, but also of communicating a fœtor to the breath, is inconceivable by those who have not pursued the inquiry with minuteness : and this offensive matter, when it thus has an opportunity of acting, communicates, through the medium of the nerves, a sympathetic pain to other teeth which are perfectly sound.

The accession of salivary moisture to the decayed portion of bone, increases its baneful influence ; while the air of the atmosphere, penetrating its dilapidated structure, is equally active

upon the nerve. In consideration of the influence of the saliva, it should be the first object of a careful dentist, when he is about to repair a disordered tooth, to see the cavity free from the slightest moisture before he introduces the gold, or whatever metal it is to be stopped with ; and if these substances be not of a perfectly dense and impervious texture, and so forced as to prevent the admission of the least air or fluid, little benefit is to be expected from its introduction, which circumstance shows strikingly the influence of saliva in causing pain of the teeth ; and I am confident it is far more powerful in this respect, than the air of the atmosphere ; for the subject of tooth-ache is as often wakened out of sleep by a sudden attack of acute pain in a warm bed-room, as in the open air of winter ; and he very commonly finds at this time, that by having lain on that side of the face where the faulty tooth exists, he has given the saliva an opportunity of collecting largely upon it. Although it appears that other metals are sometimes considered more eligible by dentists for filling the cavities of decay-

ing teeth, gold and platinum are the only two of which I can strictly approve, because they are the only metals which are not likely to become oxidated by the saliva ; whereas the inferior ones are soon acted on in that way, and accordingly require changing from time to time.

Before I proceed further, it seems expedient to introduce the following brief notice of the general characters and classification of the teeth.

With respect to the external characters of a tooth, it is usual to distinguish its *crown* or body, which is situated without the gum, and covered with enamel ; the *cervix* or neck, which is an annular depression for the more firm adhesion of the gum around it ; and the *fang* or fangs, for the reception of which the maxillary bones are furnished with sockets called *alveoli*, or alveolar processes. The fangs or roots are of a conical figure, and have no enamel ; a protection which the crown requires by reason of its exposure to the action of extraneous matter, and which disappears on the neck. They are, however, covered with a vascular membrane, continued from

that which lines their sockets, and which is reflected from the gum. The fangs are hollow, for the transmission of blood-vessels and nerves, perhaps also absorbents (which together constitute what is called the *pulp*), to the body of the tooth : but while the blood-vessels and nerves are as distinctly characterized in these organs as in any other part of the body, the absorbents are so minute as to elude detection, although circumstances, as will hereafter appear, seem to warrant the idea of their presence being necessary for natural as well as diseased operations.

Of the sixteen teeth in each jaw, the following are the usual distinctions, beginning from the central interstice, and reckoning back towards the ear, *viz.*

Two incisores, or cutting-teeth, which have been called also *lactei* or milk-teeth ; *risorii*, from their being conspicuous in laughing ; *dischasteres* (*διχαζω* to divide), from their office of dividing the food ; and *ctenes* (*ctenes* a comb or rake), because, when badly formed and arranged, they sometimes resemble the teeth of a

rake. The incisores are of a regular wedge-like figure, of which the front surface is convex, the back concave. They become gradually thickened towards the fang, which is single; and the enamel is thin and transparent on their sides.

The next tooth, or *cuspidatus*, was so named by Mr. Hunter from its pointed figure (*cuspis* a point). It is very commonly called *caninus* or dog-tooth; and eye-tooth, because the fang points towards the eye; and, when longer than usual, approaches considerably towards the orbit. This fang is also more prominent than any other; and from its having very much the character of a pillar at the sides of the mouth, Varro and Pliny distinguished the tooth by the term *columellaris* (*columella*, the diminutive of *columna* a pillar). The corresponding teeth of the lower jaw have further been distinguished by the term *angular*, from their situation with respect to the angles of the mouth, as if its supporters; but from the thickness of the maxillary bone, the columnar figure is not so remarkable as in the upper jaw

Before the days of Mr. Hunter, the five remaining teeth were merely distinguished as *molares* or grinders (*mola* a mill); their chief office being to grind or comminute the food. The last, however, is to be excepted, which, although its office differs not from that of the other molares, seems to have been called the wise or wisdom-tooth from very remote times, as it does not usually appear until the mind is considerably matured.

The two teeth next the cuspidatus were very properly named by Mr. Hunter *bicuspidates* or *bicuspidati* (*bis* twice, *cuspidis* a point), since each forms its body into two sharp points. They constitute a sort of forceps for holding the food. The fang has a furrow, and slightly divaricated point, so as to give an idea of two fangs united. The enamel is thinner on the *sides* of these teeth than on any part of the others.

The five last-mentioned teeth, from their having single fangs, have also been called *gomphioi* (*γομφος* a nail), as resembling nails driven into a wall or other substance. The three remaining teeth are

strictly *molaes* or grinders. The *molaes* have been called also *momisci* (from *μωμος* a blemish), because tartar so commonly accretes upon their necks, and other extraneous matter upon their lateral converging surfaces; for they are too generally neglected from not being conspicuous, although they require more attention than the rest, not only from their remote station and protuberances of surface, but from their vicinity to the salivary duct. The crowns of the *molaes* are broad, each forming the surface of its base into protuberances or points, commonly five in number, the better to effect its mechanical office. The whole enamel is generally thinner than that of the other teeth. The fangs divaricate very considerably, and the sockets have partitions precisely corresponding with them. The divarication is most considerable in those of the upper jaw, on account of the resistance opposed to them in a growing state by the base of the maxillary sinus. They are most commonly two, frequently three in number, particularly in the first molaris of the

upper jaw. Sometimes there are four fangs. Though the roots of the molares do not generally run to a great depth, they are by no means rarely found to do so, particularly in the lower jaw. Where two fangs only occur, one inclines forwards, the other backwards, exhibiting flattened surfaces in those directions. Where three occur, two generally incline outwards, and one inwards, which is larger and rounder than the other two.

The *dens sapientiæ* or *sapiens*, the third and last molaris, is more uncertain in its general characters than the other two. It has commonly two fangs, sometimes three, frequently only one, which is large, and exhibits traces of two or three, blending into a common body, sometimes giving an idea of the membrane having plaited itself for want of room to expand. The fangs of the molares have sometimes curvatures, which render their extraction not only difficult, but sometimes followed by very grievous consequences. Although the inclination of the teeth varies much in different subjects, it may be well to bear in

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mind that the fangs of the molares are most apt to spread in the *upper* jaw, while the inclination of the crown is mostly perpendicular. The lower molares have commonly a considerable inclination inwards.

CHAPTER XXIV.

OF THE NATURAL HISTORY OF THE TEETH— AND OF DENTITION—WITH GENERAL VIEWS OF CRYSTALLIZATION.

THE earliest period from which the rudiments of the teeth can be traced, is about the fourth month of the fœtus, when small substances of a pulpy character may be seen to proceed inwards from the gums, arranging themselves in those groove-like depressions of the jaws which afterwards become their sockets. The pulp is capable of being separated in a common mass, and its high vascularity demonstrated by a fine injection. It is also observable, that each gelatinous rudiment is already contained in a capsule, which gradually assumes the more particular figure of the individual tooth, the completion of which, for the service of life, seems to occupy about twelve months, since somewhat about the seventh month after birth is the period when the first teeth, in most instances, appear. These are thinner than

any of the others ; and those which gradually unfold themselves afterwards are progressively more thick backwards. Consequently more time is required for their perfection.

The substances which constitute a tooth are known to every one by the four general distinctions of enamel, membrane, bone, and pulp.

The blood-vessels of the teeth are supplied by the internal maxillary branches of each jaw. From the fourth month of the fœtus to nearly its sixth, the capsule of the tooth gradually enlarges, and, together with the gelatinous mass within, acquires vascularity and firmness. About this time, the first traces of an earthy deposit are visible, beginning on the parts destined for its cutting edge, or for the protuberances of its grinding surface. It is a crystalline arrangement, and seems to take place in successive layers after the manner of water into ice ; for the earthy matter radiates from central spots, and thus the radii proceeding to meet each other, and uniting with gelatinous matter, those horizontal laminæ of bone are constituted one after another, which may be

clearly seen in the tooth to form its chief substance, and which separate themselves distinctly in disease. They are of the same net-like structure as the large bones, which character seems the result of a similar crystallization.

Crystalline substances of all descriptions possess a geometrical figure by which they may be identified; and wherever the process of crystallization radiates in spiculæ from a centre, it will be found to be prismatic, the characteristic figure being imperfect in proportion as it is rapid or disturbed, as in the instance of water into ice, and perfect, as it takes place slowly and steadily. Natural phosphate of lime in the mineral kingdom crystallizes in six-sided prisms; and no figure seems more calculated to force the gelatine of bone, when uniting with it, into that cancellated structure, which, under a magnifying power, is as evident in the delicate laminæ of the teeth, as in the largest bones of the body: and further, no figure seems better suited than the prismatic, under all its various modifications, to a laminated arrangement. (Plate II. fig. 1.)

It appears by analysis that a very small portion of carbonate of lime is concerned with the phosphate, in constituting the bony substance of teeth; and as it is well known that crystalline configuration is altered and modified by a very insignificant combination of any matter of a different nature from its own, the carbonate may materially influence the irregularity of the phosphate of lime in modelling the cancelli of bone.

Moreover, the *ultimate* particles of crystalline bodies arrange themselves under secondary figures, different from that under which they appear in the aggregate, their faces or plane surfaces being precisely adapted for cohesion. The six-sided prism, for example, which is the figure of naturally crystallized phosphate of lime, and the rhomb, which is the standard figure of the carbonate, may both be constituted of tetrahedrons. The tetrahedron, as its name implies (*τετρα* four, *εδειον* a surface), exhibits four faces, each of which is an equilateral triangle; and the partial disintegration of these bodies may be another means

of influencing the irregularity of the cancellated structure. (Plate II. figs. 2, 3, and 4.) Notwithstanding these ideas with respect to the bones in general are gratuitous, I have twice seen a group of perfect tetrahedral crystals in the diseased cavities of originally well organized teeth (Plate II. fig. 5): and although after bone has been steeped in an acid, the cartilaginous remains of the cancelli resemble the structure of the cellular tissue, the filaments which constitute it are not hollow like those of the cellular tissue; and this difference in organization alone seems to support the idea that it is by prismatic crystalline arrangements the indurating matter of incipient bone is directed into a cancellated figure.

The degree of mechanical pressure, which bone and enamel receive from the surrounding soft solids in the progress of their formation, is every way favourable to the approximation and cohesion of crystalline particles.

No animal substance exhibits a higher degree of minute vascularity, than the membrane of a

tooth when successfully injected. It is formed of two layers, which are divisible, each layer being demonstrably vascular.

The vessels having furnished their earthy deposit to the bone of the tooth, next employ themselves, while it is yet incomplete, in the deposition of its enamel, which is barely observable at birth: and hence the providence of nature, in retarding the passage of the teeth through the gums, until this covering is duly fitted for protecting their vital organization.

The enamel of teeth is the most dense, hard, and durable substance of the animal machine. Accordingly its crystalline particles are the most minute, and their configuration the most obscure; the density of all substances being proportioned to the fineness of their constituent particles; their hardness to the cohesion of them; so that the more refined the particles, and the more firmly they cohere, the less subject is the substance to mechanical alteration or compression. Thus, where a substance is of extremely fine texture, the crystalline configuration under which it

arranges itself becomes totally obliterated when it is finally condensed. The diamond, for example, is familiar to every one, as possessing a more refined texture than any other natural object of the mineral kingdom. Yet, notwithstanding a lapidary may select a diamond in its unpolished state, or a portion in its polished state, which he feels confident may be worked without any danger of its breaking, because no sort of blemish is observable, he sometimes finds himself disappointed after a prosperous progress, by its cracking suddenly in a direction which he could not have expected: and this circumstance applies still more particularly to the other first rate gems of the finest texture. The cause of this accidental fracture depends wholly and solely on the figure under which the constituent particles first arrange themselves by the laws of attraction: and after a manner precisely similar, the enamel of the teeth seems to arrange itself, and to be subject to similar disintegration from certain causes. When finally condensed, its texture is exquisitely smooth and even, and remains so until the accession of some

decomposing agent, or some mechanical force, causes it to crack ; when, just after the manner of extraneous minerals, the blemish takes place in the direction of the crystallization, or the decomposition on a spot where its cohesion is the least powerful.

My considerations of this subject have led me to the following conclusions : and in projecting the scheme, I acknowledge with gratitude the obliging conference of the late amiable and skilful Mr. Sowerby, whose labours have contributed so largely to the illustration of crystallography, as well as of natural knowledge in general.

The constituent particles of enamel appear first to collect into globular molecules, which progressively form themselves into rhombs, and finally into prisms ; each globular aggregation of particles seems to move in succession from the neck of the tooth over the body, one pushing forward another, until the congeries meeting at a common centre, that of each respective surface opposes a resistance to the other. Thus, by a propelling force from the neck of the tooth, they meet a

transverse and a longitudinal resistance, whereby each globular molecule being pressed accordingly, a series of rhombs is constituted ; and the rhombs, taken in the aggregate, longitudinally, make four-sided prisms. The rhomboidal figure further favours the curvilinear contour of the tooth, and accommodates itself to the particular character of the crown of each, which circumstances are illustrated in the second plate, figures 6 to 11.

The natural crystal of carbonate of lime is a rhomb ; and another of its most common habits is that of forming stalactites. The formation of stalactites is so simple as to be intelligible by the commonest observer. They are abundant in the cavities of limestone rocks, and other situations where lime is duly supplied with moisture. A spherule of water impregnated with lime, proceeding slowly from the roof, does not readily acquire a sufficient weight to bring it to the ground. Thus certain particles of lime attracted from the roof furnish the basis of the stalactite, and by repetition of the process, a long cylindrical body is formed, after the manner of an icicle ; and where

several of these pendulous bodies are in close contact, and imperfectly formed, a transverse wavy character is observable (Plate II. fig. 12). In the same manner, where the crystalline arrangement of the enamel of a tooth has not taken place under favourable circumstances, a similar waviness of its surface is evident (Plate II. fig. 13).

Although a sheet of ice is amorphous, the prevailing angles, which are formed by its first spiculæ, are 60 and 120 degrees : and under a magnifying power, the interior of a hollow icicle exhibits elegant crystallizations of three-sided and six-sided prisms. The crystallization of snow is more generally perfect than that of ice ; each flake consisting of a vast number of star-like crystals, the most prevailing of which are figured in the second plate (Nos. 14, 15, 16) : but there are still other modifications of the star, each of which is also hexagonal. It seems probable that the molecules which constitute the prisms of ice, the flattened stars of snow, and the octohedrons of hail, are all tetrahedrons : and these several configurations

of pure water appeared to me worthy of being adduced, as exemplifying the laws of crystallization, which one of the most familiar natural objects must obey in common with solid minerals. The enamel of the newly developed teeth of children, and particularly that of the second or permanent set, very commonly exhibits a transverse and longitudinal series of lines, which I am disposed to regard as a valid testimony of the natural arrangement I have attempted to explain.

The enamel has no sort of connexion with the living powers of the tooth, as may be seen satisfactorily in the teeth of young animals which have been injected with colouring matter soon after its completion. It is no other than a species of armature, precisely corresponding with the shells of crustaceous animals, some of which forsake them at certain periods and form new ones, while others alter the forms of them altogether,—plainly showing that the substance is inorganic. The extra-vital nature of the shells of marine animals has been fully demonstrated by Sir An-

thony Carlisle in his physiological lectures before the College of Surgeons, and in tracts which he has published in the philosophical journals.

Shells are of more glossy, firm, compact, and refined texture, in proportion as they are supplied with animal gluten or gelatine. In this respect, also, the enamel of teeth resembles them. Its earliest deposition, which takes place on the crown, is soft, earthy, seemingly amorphous, and easily scraped off: but, combining with animal gluten, it soon becomes firm, and assumes its crystalline character, the striated appearance of which is constituted, according to the views which have been offered, by a series of prisms. By the gelatinous moisture which the enamel so constantly receives from the substance of the gum, and which so abundantly lubricates its surface during the progress of its formation, it has the glossiness and evenness of texture which porcellaneous shells, for example, the *Cypreæ*, so commonly exhibit, from a similar abundance of mucilage. But where gelatinous matter is not duly supplied, as is often the case in unhealthy subjects, the enamel

fails of gloss, density, and smoothness of texture. An insufficiency of gelatinous moisture seems also to influence a corrugation of the membrane, and sufficiently to account for those depressions and general unevenness of surface, as well as the notch-like edges which bad teeth so commonly exhibit.

Of the larger proportion of animal gluten which enamel contains above bone, an additional proof is furnished by the horny appearance of it in old age, at which time the bones become particularly brittle from the decreased vigour of the circulating system, and deficiency of gelatinous fluid. In advanced age, too, the cavities of the fangs contract, and thus destroying the vital organs of the pulp, and cutting off their communication with the more powerful ones which have hitherto supported them, the teeth fall out; since the gums alone have not long the power of holding them by that flimsy membrane which they furnish as a lining to the sockets, and an investment of the fangs. This circumstance also shows why old people are not affected with tooth-ache ;

for the contraction of the fang around the nerve may cut off its sensitive communication with the body of the tooth, long before the minute ramifications of the blood-vessels of its membrane so far give way as to loosen it. The languor of the circulation, too, accounts for the general disposition of the gums to recede from the teeth at this time of life, because the capillary vessels which crowd their substance are terminal.

The striated crystalline arrangement of the enamel, according to the closest analogies, must be prismatic, and the crystallization of its integrant molecules rhomboidal. Cracks of the enamel seem to support the idea of a prismatic arrangement, for they are always perpendicular in the direction of its striæ. Fractures of the enamel are always angular or diagonal, and the aggregation of rhomboidal molecules seems to favour this direction of the fracture; for if the prismatic striæ, which may be observed to place themselves longitudinally when the enamel first appears, had not a secondary arrangement of their integrant molecules, fractures, like cracks,

would commonly take place longitudinally, and but rarely, if ever, diagonally.

It will be necessary to bear in mind these views of crystalline arrangement, on arriving at the observations which are about to be offered on the subject of caries.

All earthy bodies, not only of strict crystalline figure and substance, but even where an approach to it is observable, fracture at angles which are eminently characteristic of their chemical composition, and capable of being amply demonstrated.

Bone has a great advantage over enamel in its communication with the circulating system, whereby its gelatine is constantly preserved in a certain degree of moisture; whereas enamel, when once perfected, is dismissed from all connexion with the vascular system. Hence analysis demonstrates the presence of a considerable proportion of gelatine in bone, whilst in enamel it is now inconsiderable, although during its progressive deposition so abundant. The bony part of a tooth continues to grow, and lengthens its

fang long after the enamel is completed. The most refined enamel is unfortunately most readily acted on by external causes ; and teeth of the most perfect internal organization, suffer also most readily and most acutely from the ravages of decay.

The nerve and blood-vessels of a tooth are comprehended under the indefinite term of its *pulp*, and which must have originated from a very superficial examination of those objects. That the nerve and blood-vessels are accompanied by an absorbent branch, analogy warrants the fullest confidence ; for such must be required not only for exhausting the fangs of the temporary teeth, but for certain effects of disease, for example, what is called ulceration of a tooth. But that the idea should be opposed by some physiologists, is no matter of wonder, when it is remembered, that there are those who deny that the teeth are furnished with *nerves*. It is impossible that such persons can ever have examined the substance of a tooth with common attention ; for in well organized teeth, the *nerve* and *its*

ramifications are as well characterised as the optic nerve itself, on its egress from the brain. The branches of each individual nerve ramify throughout the bony substance of the tooth, and terminate on its membrane; whence it is, that the enamel itself, in severe attacks of tooth-ache, often seems acutely sensible at particular points. Every one knows that the front teeth become painful less frequently than any of the others; a circumstance accounted for by the distribution of the nerves: for as the branches which supply the jaws ramify from within the sides of the mouth, distributing branches as they pass towards the middle, these branches become more fine and delicate, and proportionably less sensible, as they approach the central teeth; nerves and blood-vessels, and all the vascular apparatus of the animal fabric which extend themselves by ramifications, diminishing gradually in diameter as they approach their extremities. The influence of the nervous system at large upon the teeth, shows itself in the change of colour which they experience, from the sudden influence of mental agitation, when from

a clear white they become of a dull brownish or grayish hue, which recedes like the iridescent tints of pearly shells and similar animal substances, the natural whiteness being perfectly restored when tranquillity is re-established. By what influence are our teeth "set on edge," according to common language, if it be not by the intervention of nerves?

The distress and inconvenience which children suffer in cutting their teeth, have been the occasion of many mistaken ideas concerning the process.

Dentition of itself cannot be called a disease, because it is a regular operation of nature; but the degree of irritation which necessarily attends it is sufficient to excite such disorders as a child, by its peculiar habit, is most prone to; those of full habits being affected with inflammatory forms of fever, which, without proper care, are apt to take on an alarming character, but which commonly yield to a cooling and laxative regimen; while those of weak and rickety constitutions are affected by ill-conditioned secretions of the sto-

mach, which are readily relieved by the judicious administration of such purgatives as are best adapted to their age and habits.

Herbivorous quadrupeds require neither a stem of coral nor the vague nostrum of an anodyne necklace, because they take not such food into their stomachs as can exert a baneful influence, nor do their mothers impart any to their milk by their simple matters of aliment. In nine instances out of ten, the stomachs of infants at the breast become disordered from the improper food, drink, and clothing of the mother, rather than from any natural infirmity of their own.

The practice of furnishing children with a stem of coral is of great antiquity, and seems to have originated in a superstition which obtained very extensively among the Romans, that coral was a charm against the "evil eye," by which may be understood witchcraft: and although superstitions concerning the evil eye exist to the present time both in Italy and in this country, the coral seems only to be made account of by nurses, for rubbing the gums. It was, however, the amulet of the

Roman children : and it seems likely that the bells were first added from an idea more weighty than that of their supplying a toy. The Neapolitans, who are among the most superstitious of the human race, have charms against the *mal occhio* at this time : and at Bauli, at Miseno, and other places, its mischievous influence is believed to be averted by hanging over the fore door a plant of the common American aloe (*Agave Americana*), which grows profusely around the bay of Naples. This is just like the English superstition of nailing horse-shoes on the threshold. The great empire of witchcraft, however, is the stomach and alimentary organs, which communicate by some of the disordered states herein described, aberrations of sensorial perception, sympathetic affections of the entire nervous system, the circulating system and the muscular system : and these, from obscurity of their cause, ignorance refers to the influence of supernatural agency under various denominations. Half the muscular affections called rheumatic proceed from a disordered stomach : cramp, as it is commonly

called, is among the foremost tortures of flatulence and general derangement of the alimentary viscera; and from such causes alone, proceed the convulsions of infancy.

It may be argued, from the continual propensity of infants to gnaw while teething, that nature points out the utility of something to compress the gum. A piece of fresh liquorice root answers this purpose, without severely bruising: and its juice is wholesome, and agreeable to the child.

For the relief of that irritation which necessarily attends the process of teething, nature, with her usual beneficence and simplicity, has sufficiently provided, in the increased secretion and discharge of saliva, and in the looseness of the bowels, which every one is aware may be expected to occur, and the checking of which is unwise in the highest degree.

If the relaxation be such as to become unusually troublesome, let a purgative be administered, to clear effectually that disordered secretion of the mucous membrane of the stomach and intestines, which occasions it; for as long as dis-

ordered secretions exist, even in small quantity, the griping uneasiness and looseness must not be expected to subside. If sedatives be afterwards thought expedient, they should be used with the greatest caution.

CHAPTER XXV.

CONCERNING DISORDERED STRUCTURE OF THE
TEETH—COMPARATIVE PHYSIOLOGY—GE-
NERAL TREATMENT OF THE TEETH AND
THEIR DISORDERS—CAUTIONS AGAINST THE
PRACTICES OF UNQUALIFIED PRETENDERS.

WHEN the gradual expansion of the bodies of the teeth is considered, it is evident that an undue approximation of their lateral surfaces is likely to take place, so as to become capable of exerting a morbid influence, as is well demonstrated by Mr. Bell, of St. Thomas's Hospital, in the *Medico-Chirurgical Transactions*. It is moreover evident, that the parts which form so close a contact, are not only rendered a medium for retaining small relics of food, which become noxious by putrefactive fermentation, as many writers have observed, but also for the deposition of vitiated mucus and saliva.

The two causes conjoined, appear to account for the most frequent forms of decay, but by no means for every form of it.

If there be no other cause of caries than these, how do teeth become affected with the disease, where there has not been the slightest approximation of their lateral surfaces, where no foreign matter can possibly have lodged, and where, by constant attention, no particle of tartar has been permitted to accrete? Yet, under every circumstance of care on the part of the possessor, and every precaution which art, ingenuity, and experience can suggest, the most healthy-looking teeth do become carious from their outer surfaces, whether they be front teeth or back,—no matter how refined and perfect the surface,—the disease beginning with a small depressed spot, and proceeding inwards without discolouring the enamel: but as the absorption of the enamel advances (and it would seem a partial decomposition of this substance takes place previous to its absorption) the bone becomes exposed; and if not at first materially discoloured, it darkens as the decay proceeds, exhibiting clearly its laminated arrangement. Besides this, instances are no where

wanting, of the lower plane surfaces of the grinding teeth of the upper jaw evincing the first traces of decay, under circumstances similar to the preceding, viz. where, by reason of ample interstitial spaces with respect to the adjoining teeth, no pressure can possibly have been exerted on the sides of the diseased tooth, or opportunity have been furnished for the deposition of extraneous matter; and where, also, extreme care has been observed to prevent accretions: and even if this had not been the case, it is by no means easy to imagine, how any sort of substance can have lodged upon the broad, and comparatively level, under surface of a large grinding-tooth, attacking only its central part, and thence proceeding inwards. This instance, however, is not so distressing as the last; because, if the mischief be detected in tolerable season, the simple operation of clearing out the carious portion, and stopping the cavity with gold, may remedy the evil for life, if subsequent attention be observed: but the former calamity, namely, the

denudation of the outer surfaces of the flat teeth, defies, alike, all attempts at repairing its ravages, as well as arresting its incipient influence.

By the observations which have already been offered, it will be inferred, that I conceive decay of the teeth to be various, in its kind but not in its cause: that the process is chemical, and altogether influenced by the operation of the stomach and its contents, as well as that of certain matters of aliment, which have an opportunity of acting as soon as they are taken into the mouth; for example, crudities in the shape of unripe fruits, fermented liquors, mineral acids, and numerous kinds of trash, whether solid or fluid, which the recollection of most persons must tax them with indulging in; or, where this is not the case, an unfortunate state of the digestive organs dependent on peculiarity of constitution, and, in some instances, on continued distress of mind: for, in either, the various natural secretions may become disordered beyond any remedy of the medical art.

RADOLIFFE
A

Whatever promotes acidity of the stomach, promotes also a morbid condition of the teeth.

When caries has once established itself, its tortures are readily called into action by various incentives, which it is unnecessary to enumerate, and none so frequently as cold and rheumatism.

Where the lateral surfaces of the teeth first become affected, the theory of putrefactive fermentation on the enamel seems every where to hold good, *jointly* with that of compression ; for all the surfaces of the side and back teeth have a degree of irregularity, favourable to their encroachment upon each other, which, in the course of their protrusion, is no where so much exerted as on the sides, in consequence of their sac-like figure : and the crystalline arrangement of the enamel, which I have attempted to explain, is highly favourable to the disintegration of its substance by mechanical pressure, as well as by chemical agents. Thus such points or irregularities as come in close contact, afford opportunities not only for the lodgement of minute relics of food,

but also for the deposition of vitiated mucus and of earthy matter from the saliva ; so that when once the enamel has become decomposed, these insidious agents undermine the tooth on which the greatest degree of force has been exerted by its neighbour ; and as soon as the caries has gone so far through the bone as to meet its nerve, and not before, the pain of tooth-ache becomes established : for, as I have ventured to advance that it is the irritation of decayed bone upon the nerve of the tooth that is the exciting cause of this malady, the reason is evident why caries may, for so long a time as it commonly does, escape the observation of the sufferer. Further, when it is remembered that in some subjects the ramifications of the main nerve are inconsiderable, while in others they are both minute and numerous even between the membrane of the bone and the enamel, it is easy to account for the extraordinary pain which a tooth has occasioned, when only a very small spot of it appears to be decayed, whilst another infinitely more decayed has not been painful either so long or so violently. These dif-

ferent appearances of teeth, after they have been extracted, are often a matter of surprise with those who have not investigated their structure; but sufficiently evident to those who have. The commencement of decay on the lateral surfaces of the teeth, has directed the practice even of the most uninstructed from considerably distant times; and itinerants of both sexes assuring the credulous that, by adopting certain measures, they should never again experience tooth-ache, have tortured them by stuffing cotton, charged with essential oils or mineral acids, between every interstice for a specified length of time; before one-half of which was expired, such inflammatory action of the surrounding parts and such nervous irritation of the whole frame has been induced, as to render the patient unable to endure the process of alleged cure.

Where caries attacks the broad under surfaces of the upper teeth, it first shows itself at some point of contraction inwards, near about the middle: and when it is remembered that the teeth first arrange themselves individually after the

manner of sacculi or little bags, it is not difficult to conceive that the indurating matter which they subsequently receive by degrees, may, in the course of its arrangement, cause contractions of the still yielding membranous sac in its base, to a depth greater than that of the usual natural depressions, and that those points of contraction being of less firm and solid texture than the rest of the enamel, it is there more liable to decomposition by the constant accession of acrid saliva and various other agents; and that from such points the caries accordingly proceeds inwards. In like manner, it would appear to my apprehension, the denudation of the front surfaces of the incisores and cuspidati may be accounted for; in which instance, by a trifling failure of cohesive property in the crystalline particles of the enamel, an opportunity is given to such fluids as are capable of exerting a decomposing influence to act upon a spot which is at first so minute as to elude observation, until the evil having established itself, the effects of it begin rapidly to unfold themselves. Thus, the enamel having once given way,

a process similar to the ulceration of the soft solids attacks the bone of the tooth.

If the enamel of a tooth be steeped in a weak acid, it falls into powder : and such is the appearance of faulty portions removed by ordinary operations on the teeth, since diseased action destroys altogether the crystalline configuration : and it is evident that acrid saliva may gradually corrode an imperceptibly minute defect to a great extent.

If the bone of teeth be steeped in a weak acid, a soft pulpy substance remains, which is no other than the cartilaginous substance of its lamellæ, and a modification of what is evinced by the largest bones of the animal frame, when submitted to similar experiment.

While we lament, with too much reason, that human ingenuity has not yet devised any means of obviating or repairing these grievous and painful ravages, and that nature has not endued us with powers to direct, at pleasure, the secretion of earthy matter to any particular spot for a similar purpose, we have a most humiliating reflec-

tion in observing the powers of renovation which are enjoyed by the inhabitants of shells, some of which, after their testaceous coverings have been broken, whether on the edges, in holes or in cracks about the middle, no matter where, possess the power of directing, from their secretory vessels, a sufficient quantity of calcareous matter and animal gluten to repair the injury effectually ; whereas man has not the power of directing a single particle either of earthy or glutinous matter from his secretory system, to repair a small deficiency of enamel which is literally a modification of porcelain shell ; and the loss of which makes every trifling accession of cold acutely distressing.

The powers of renewal which are exercised by the inhabitants of testaceous shells were first demonstrated by Sir Anthony Carlisle, who also above twenty years ago directed the attention of the Linnean Society to the crystalline arrangement of egg-shells, and showed that it proceeded under a prismatic figure, from surface to surface ; a circumstance which may be clearly seen in the

fracture of an ostrich's egg under a moderately magnifying power.

While an acid and acrimonious state of the circulating system seems to influence the foregoing forms of disease; in scurvy, on the contrary, an alkaline excess seems to prevail, as I have already instanced. That scurvy exerts most powerful ravages on the teeth, there cannot be a doubt; and wherever considerable sponginess of the gums exists, a proportionably faulty state of the teeth may be suspected; the membrane which invests the fangs, being supplied by the gum, furnishes a ready medium for communicating disease to their whole bony structure. It is not unfrequently a constitutional predisposition to this disease which discolours teeth in the progress of their formation; so that they are originally developed of a blackened and unsightly hue.

Sea scurvy, which is the very worst form of the disease, is the undoubted offspring of unwholesome diet, inattention to personal cleanness, and insufficient ventilation of the ship. So devastating is its influence, that the bones are some-

times literally dissolved by the caries which it induces. Scurvy often exists in the gums in a very latent form ; and its mischievous effects seem frequently to have extended themselves into the bony part of the teeth (the fangs not having the advantage of enamel, which far more slowly gives way to morbid chemical agents) before it was at all suspected by the patient ; habits of cleanliness being seldom the most exact in the subjects of scurvy. Where the teeth and gums are suffering from its influence, the treatment of the general health is the only thing which may be looked to for efficient relief after the necessary mechanical offices of the dentist have been performed. After a free course of purgatives, and a proper dietetic regimen, vegetable acids appear to be more effectual than mineral in this state of the system, if used with circumspection and persevered in for some considerable time. A form of scurvy, however, is by no means uncommon under circumstances far less aggravating than the preceding ; and a disposition to it is frequently observable among the lower classes of our rich inland coun-

ties, where they indulge largely in the use of gross food, and fermented liquors, cherishing the too general vulgar prejudice in favour of a stimulating diet.

A dentifrice of some kind is used by every one; and out of the absurd farrago with which the world is insulted, none are so safe, or perhaps so effectual, as the simple argillaceous earths, of which Armenian bole finely levigated is at least as good as any; and it seems best used by previously rubbing on the brush a little Spanish soap after it has been moistened with luke-warm water. Testaceous powders have been in use from the earliest days of manufacturing dentifrices; and are at this time among their most frequent constituents. Next to these, magnesia and pumice stone have been dressed up in every disguise which artifice could invent: and it is fortunate if they are not accompanied by more mischievous substances. If the provisions of nature, however, were not rendered insufficient by our habits of life, nothing more active than pure water would be necessary for cleansing the teeth: and next to this, I can confidently recommend

nothing more powerful than the earthy and saponaceous combination alluded to.

If the gums require a sedative, none seems more eligible than camphorated spirit largely diluted with water. If they require a stimulus, none is perhaps better than some dilute form of citric acid, applied upon a sponge; but every affection of the gums demands watchfulness of the general health far more than local attention.

The only proper objects of the dentist are—

I. To promote an even and natural arrangement of the permanent teeth in youth, after the temporary ones have been shed, by rectifying irregularities as circumstances may require; and in adult age, to promote the mechanical adaptation of surfaces by the partial removal of uneven portions and ragged edges.

II. To widen the interstices where they are naturally insufficient; from which operation no bad consequences are to be apprehended; since partial exposures of the bone do not induce decay, if regard be had to duly cleansing the teeth and regulating the stomach.

III. To arrest the progress of caries, before it has made such incursions as to render art of no avail, by removing the minutest trace of it, and substituting a dense metallic stopping.

IV. and lastly. Where caries exists to such an extent as to leave little hope of relief by careful and judicious removal of it, to extract the painful tooth without delay.

But it is my duty to caution every one against a most barbarous operation recommended by some dentists, more terrible in its tortures than any which belongs to the severest province of scientific surgery. I allude to the drilling out the entire bone of the crown of a tooth, or rather, the attempting to do so; and directing barbed instruments into its fangs, with a view to overcome its sensibility by excising the nerve.

So common however is the prejudice in favour of what, in the vague language of inexperienced persons, is called "destroying the nerves of teeth," and particularly by cauterising, that a thrifty housewife talks of having effectually done so with her red-hot knitting-needle, at the ex-

pense of only momentary pain. But let it be inquired what kind of teeth were so treated with success; and an instance would be rare indeed of their being well organized and forming part of a good set. Under such circumstances, and no others, does the dentist succeed in a similar object.

To show the inefficiency of attempts at subduing the nervous influence of disordered teeth, the protracted local sufferings which may result therefrom, and their grievous consequences to the system at large, it may be excusable to adduce a particular case.

A gentleman, thirty-one years of age, of temperate habits, of good general health, and under circumstances in every respect favourable to the treatment of any local disorder, having for a considerable time endured great pain of the first molaris on the left side of the lower jaw, was advised by a dentist against having it extracted, because he had suffered very alarmingly on a former occasion from the consequences of the operation. Accordingly it was stopped with metallic

foil. The tooth was of great size, highly organized, and part of what, a very few years before, had been one of the most perfect sets imaginable. For a few weeks the pain was not serious, though very troublesome; but it now became so intolerable that it was advised the cavity should be re-examined, and the stopping changed. At the commencement of the operation, about a fourth of the enamel broke suddenly off, and an effort was made to extract the tooth. This, from unfortunate circumstances, failed; and the patient submitted to an attempt at eradicating the nerve, which severe measure was confidently pronounced effectual from the portion of pulp which was dragged up, and the appearance of blood which attended it; but acute pain returned the same evening. During more than a fortnight he contented himself with the occasional mitigation of pain which was afforded by stuffing the cavity thrice a day with essential oils, camphor, and opiates; minute laminæ of bone making their appearance from time to time, when the cotton was changed. His sufferings becoming incessant,

and his health declining for want of rest, he now consented to the desperate measure of scooping out every portion of bone which could be reached, so as to leave only the shell of enamel; and the drilling barbed instruments into each fang, with a view of effectually destroying its nerve. In the course of an hour and half, the enamel was cut with great dexterity into a more convenient form than the accident alluded to in stopping had rendered it; and all the bony substance within the crown apparently removed. But this appearance was fallacious, as will presently be seen. The agonies induced by drilling the fangs, to use his own expression, "no language can describe." The minutest branches of nerve at the extremity of every finger and every toe were affected in the acutest manner; and every muscle of the whole frame convulsed. It was, nevertheless, some consolation for the sufferer, on recovering, to hear his operator declare, in the most confident terms, that the tooth never again *could* be painful; and that when filled with gold it would be as serviceable as ever. Twenty-four hours,

however, had not elapsed, before the fallacy of this declaration evinced itself: and some weeks having passed on with continual suffering, the cavity being daily filled with every sedative which could be thought of, and, notwithstanding the apparent removal of the entire bone, decayed laminae still coming away, the patient was too much reduced to bear another attempt at extraction. A new compound metallic stopping was now tried; but after a short time the pain returned by degrees to its former violence. The metal was removed; and for more than three months every application made to the tooth, and to the integuments of the jaw, which could be suggested by the ablest medical practitioners: nor were the most vulgar nostrums left untried. This train of distress had now so far influenced the nervous system, that an obstinate fever established itself, accompanied by frequent accessions of delirium for many weeks, during which time the patient often seated himself for the purpose of having the tooth extracted; but the slightest touch of an instrument, even against a

perfectly sound tooth, produced the most violent agitations, and which were literally a modification of such as affect the subject of hydrophobia on the approach of fluids. Six full months had now elapsed, when, the muscular system being as much reduced as the nervous, and the patient destitute of all power to resist, he was relieved, in a moment of insensibility, by the extraction of the tooth in fault: and the appearances which, on an attentive and minute examination, it presented, will serve to prove how unpardonable any practitioner must be, who should trifle with the health, and cripple the exertions, of any active individual, by a repetition, or even once performing an operation, so excruciating, useless, and discreditable, as that herein described.

The great portion of bone which had been removed by scooping, and the exfoliations of lamellæ which had so repeatedly occurred, seemed now of no account, comparatively with the substance of bone which remained; while decayed portions, sufficient to cause continual irritation, adhered to the membrane within the enamel, over

which membrane several branches of perfectly sound nerve extended themselves. So very inconsiderable a portion of bone had lost its vitality by the long continued application of ardent spirits, essential oils, mineral acids, and other reputed destroyers of organization, that it was evident the use of them had been as ill devised as their effects were nugatory; for in the neck of the tooth, and that bony part of the crown which remained, small portions only of nerve were partially dried up and withered, while others were healthy, and reaching the very extreme parts of the bone and its membrane. The nerves of both the fangs were of great size, and the blood-vessels accompanying them, distinct and healthy. In one fang, about a fifth only of the nerve had been destroyed by the formidable operation of drilling; while all the rest was in its fullest vigour, sending off, around the point of the fang, six distinct and well characterized branches, through openings no less distinct and well characterized. In the other fang not the slightest effect had been produced on the nerve, which, after the same

manner as the first, divided itself into five branches, which passed through five corresponding foramina.

Now as dead and living matter can never come in contact without the former being a constant source of irritation to the latter, the withered portions of nerve in contact with the living, independently of the presence of decayed bone, were sufficient, in the foregoing instance, to account for the continual recurrence of pain after every remedy had been tried : and unless instruments can be contrived to root clearly out, not only the main body of the nerve from each fang, but also its secondary branches, no lasting benefit must be expected from drilling, and the only instrument really eligible in such a case, is that which extracts the tooth altogether.

An intermittent fever of some weeks duration, and which is the common offspring of innumerable nervous progenitors, brought this distressing case nearly to a close, at the end of rather more than eight months from its commencement : but

thirteen months had elapsed, before the general health of the patient was in any degree re-established.

If dentists would content themselves with enterprises no greater than are sanctioned by the dictates of reason and experience, they would enhance a firmness of reputation more lasting than the affectation and presumption of doing impossibilities could ever establish ; and acknowledge the limitation of their art in common with that of the more weighty branches of surgical science.

While I urge the comfort and advantage of stopping disordered teeth with gold, under due precaution of clearing and drying the cavity, I cannot go a step beyond the other operations which I have recommended : and it is clear, by the Surgery of Dionis, that the lapse of upwards of an hundred years has suggested nothing further to the circumspect practitioner. But it should, notwithstanding, be remembered, that these preparatory organs of digestion and nutrition are still worthy objects of the anatomist, the physiologist,

the chemist, the naturalist, and the practical surgeon ; for it is dreadful to reflect upon the injuries to health, and the actual causes of mortality, which are daily levelled upon the unwary, by "buffoons and chatterers, by quacks and mountebanks," and by the most illiterate mechanics, in meddling with disordered teeth. Out of the various alarming instances which I have witnessed, one may be named, to show how soon the most inveterate influence of any constitutional predisposition to particular disease may be called into action by blunderers in this practice.

An industrious artificer, twenty-seven years of age, and of a habit predisposed to scrofula, applied to a blacksmith (who plumed himself upon his skill in the extraction of teeth, and who, of course, had no idea of the maxillary sinus and the diseases incident to it,) for removal of the second molaris on the left side of the upper jaw. The fangs of the tooth communicated with the sinus ; and after much rude, clumsy handling, and desperate laceration of the jaw, it was forced out. Diseased action soon supervened, the bone fell

into a fungous state, the spongy excrescence went rapidly on increasing for two years, defying every effort which could be devised to arrest it; at the end of which time, death put a stop to one of the most grievous protractions of agony and helplessness, and removed one of the most dismal and disgusting objects of disease ever witnessed. While the right eye and cheek only retained the semblance of a human being, the whole of the left side of the face had extended to a monstrous convex protrusion pointing outwards and downwards, far larger than the whole head; the integuments, stretched to their fullest extent, became ulcerated in several places; the mouth was forced into a circular figure of great diameter, the right angle of the lips pointing upwards, the left downwards; while the diseased bone and gums with the two central incisores, and left cuspidatus, sticking diagonally out from the putrescent mass, left only an opening of about half an inch in diameter at the right angle of the lips, through which alone fluid nutriment could be introduced for a long time previous to death. The left eye

had dissolved by ulceration ; while the lids, nearly closed, were stretched to their utmost, upwards and outwards, discharging a putrescent sanies. In this direction, also, the frontal bone had yielded greatly, while the nose retained nothing of its form, except the distended and disfigured nostrils.

The membrane lining the maxillary sinus is spongy and glandular : and a carious tooth whose fangs are connected with it, may give origin to a tumour through inflammatory irritation, before the tooth itself has become so painful as to render its extraction necessary. The operation furnishes a new source of irritation to the disordered membrane, and probably to the bone itself : so that mischievous consequences proceed rapidly. Polypi are sometimes found in a disordered maxillary sinus ; and its glandular apparatus has favoured the accession of cancer in habits predisposed to the disease.

Continued evidence of the dangers and unfitness of intrusting operations on the teeth to unqualified pretenders, should awaken those medi-

cal students who are intended for general practice in the country, to a serious consideration of every thing connected with the subject, while yet they have the advantage of collecting such information in the metropolis ; lest, when it is too late, they regret their ignorance of remedies which would ensure them the gratitude and confidence of many a sufferer.

CHAPTER XXVI.

SUMMARY OF THE AUTHOR'S PARTICULAR VIEWS OF THE STRUCTURE, NATURAL HISTORY, AND DISORDERS OF THE TEETH—FURTHER REMARKS ON DIGESTION—ON DIETETICS—ON ATMOSPHERE AND LOCALITY, WITH PARTICULAR REFERENCES TO ITALY—CONCLUSION.

THE following corollaries [briefly exhibit the conclusions which my investigations of the structure, natural history, and disorders of the teeth have led me to adopt—viz. :

I. That enamel is constituted by a longitudinal arrangement of prisms ; and that each prism is made up of an aggregation of molecules, each distinct figure of which is a rhomb.

II. That longitudinal cracks of the enamel are directed by the corresponding arrangement of its prisms ; and that they may be rendered undu-

lating, as they often appear by the rhomboidal figure of those molecules, which in the aggregate compose the prism.

III. That the arrangement of the rhomboidal molecules directs the diagonal fracture of the enamel.

IV. That the aggregation of rhomboidal molecules mechanically facilitates the disintegration of the enamel by compression from the lateral surfaces of adjoining teeth, thereby giving extraneous matters an opportunity of acting at large upon the whole substance of the tooth compressed.

V. That the aggregation of the molecules is favourable in particular to the insidious agency of acrid and decomposing fluids, which are modified as to their chemical influence by the state of the stomach, by various matters of aliment as soon as they come within the lips, and by various nostrums which are used for cleaning the teeth, and, according to the language of quackery, "strengthening the gums."

VI. That by this decomposition of the enamel

a denudation of the bone is effected, and an ulceration of its substance established, after the manner of an ulceration of the soft solids.

VII. That by a similar decomposition of the enamel at a depressed or contracted point, the decay of the lower surfaces of the upper teeth, and of the upper surfaces of the under teeth, is accounted for.

VIII. That the cancellated structure of bone is directed by the shooting of prismatic crystallizations of calcareous earth through gelatinous matter, the viscosity of which, together with the force which one prism may oppose to another, occasions those irregularities of space which the cancelli exhibit; and that such opposing forces may also occasion a disintegration of the molecules of the prism, which is also a cause of irregular structure.

IX. That the length of time which caries may exist without giving any pain, depends entirely upon the distribution of the nerve; and that tooth-ache takes place sooner or later in proportion as its branches are superficial or deep seated,

so that the finest tooth with only a small carious defect, may occasion as much agony as one with a vast cavity.

X. That decayed bone is the actual and immediate cause of tooth-ache, as soon as it comes in contact with any part of the nerve.

XI. That the nerve ramifies throughout the substance of a perfect tooth, and distributes filaments upon the membrane of its bone immediately under the enamel.

XII. That when scurvy attacks the gums, its baneful influence is communicated to the membrane of the fang and socket; and from thence by absorption to the internal substance of the teeth, whereby the looseness so commonly attendant on scorbutic influence is readily accounted for.

XIII. That tartar is no other than a condensation of vitiated mucus and extraneous matter, which a disordered stomach occasions upon the surface of the tongue, where, by reason of its viscosity, the saliva has not the power sufficiently to dilute it; and that by inattention to

the constant cleansing of the tongue, it actually acquires a degree of putrefaction, which accounts for the dark colour of tartar that has long been allowed to accrete.

XIV. That acrimonious saliva excites the painfulness of diseased teeth more frequently than any other stimulant, and that a regulation of the stomach alone may be looked to for a palliation of morbid acrimony.

Diseases of the teeth then, to my apprehension, depend altogether on constitutional circumstances, from the several causes, of which I have attempted to demonstrate the stomach as the great original source. It is undoubted that disorders of the stomach, and disorders of the teeth, have become progressively more formidable with the advancement of civilization and the general refinement of domestic habits.

Fermented liquors, and especially wines, besides acid fruits, vinegar, sugar, and many seasonings of our food, act chemically upon the teeth as soon they enter the mouth. Before passing out of the stomach they again deteriorate the general con-

dition of the mouth ; and after digestion, exert a morbid influence on the secreted watery fluids at large when used too freely. The provision of nature for a mechanical division of alimentary substances previous to their being submitted to digestive agents of a chemical kind, is sufficiently evident in the varied forms and powers of the teeth not only in man but in all animals that live on solid food. In those herbivorous quadrupeds where the teeth are not so powerful, even vegetable matter has to meet a greater degree of muscular action in preparatory sacs ; and moreover to be remasticated before it is received into the true stomach. In birds, no mechanical action is exerted in the mouth, but the gizzard, which is a proportionably more powerful muscular instrument than belongs to the digestive apparatus of any other class of animals, has abundant power to press and divide their food previous to its being suited to nutritive offices ; and in this organ, it is never without the aid of further mechanism from small pebbles and particles of sand, which birds have naturally a propensity to swallow. In fishes,

there is a gradually increasing degree of mechanical power in the teeth proportioned to the solidity of their food, from such as is pulpy to such as is more substantial: and near about midway the scale of this mechanism, perhaps, may be classed the teeth of the *Anarhicas lupus* or sea-wolf. Carnivorous animals which suddenly tear their food and masticate but little, have their stomachs furnished with more powerful muscular fibres than such as more duly divide their food previous to its being received into the stomach.

The muscles of respiration at large, evidently assist the digestive process and the general functions of the whole alimentary passage. Celsus thought the habit of reading aloud after eating, diminished the inconveniences of weak digestive powers; and I believe both the mental excitation and bodily stimulus thus promoted to be of service to persons so circumstanced, when it is not convenient to take exercise in the open air. Persons who eat rapidly, and without due mastication have seldom good digestion; and a habit of this kind cannot be too industriously checked in

children and young people : while for those who have unfortunately lost their teeth, solid food should be prepared in as softened a form as possible ; since no assistance to mastication must be expected from artificial teeth. Our solid nutriment is more than adequate to the demands of nature, however plentifully meat may be dressed ; and the vulgar prejudice in favour of imperfectly cooked animal food is as mistaken as the meat itself is unsightly. Under-dressed food, of any kind, is not suited to nutritive assimilation ; and that of an animal nature, in particular, favours scorbutic and erysipelatous eruptions of the face and skin. It is certain that scorbutic and erysipelatous diseases and apoplexy are neither so common or so malignant as in those times when three substantial meals of animal food with fermented drinks, were adopted daily. The chemistry of Queen Elizabeth's kitchen appears, by the publication of her majesty's chief cook, to have been more gross than any natural powers of the human stomach were adequate to meet, and much less to subdue.

That climate has a considerable influence on our propensities for solid food, I am not disposed to doubt: but there is no necessity to impose on ourselves a system of inordinate eating in England or elsewhere. A temperate Englishman is more than satisfied in France, with the productions of a French kitchen and a French cellar: and in Italy, he will be satisfied with a still less proportion of solid food. It is perhaps the humidity more than the cold, or at least, the combined cold and humidity of an English atmosphere, that creates an inclination for the free use of solid food. Still, we find the peasantry of Scotland, and the peasantry of Ireland, chiefly living upon vegetable and farinaceous matters: but even in their most fertile districts, neither are remarkable for the agile movements and cheerful habits of the rural labourers in cultivated tracts of France and Italy; while the Dutch, waddling upon vapourish swamps, or crawling upon the deck of a trekschuit, simultaneously blunt the tone of their stomachs and their sensorial powers with eternal tobacco. The accession of cold and moisture in all Europe, seems to

create an increased disposition in the lower classes, for diffusible stimulants of some kind. Throughout the British dominions, it is alkohol under all its Protean shapes and denominations—in France, Holland, and Germany, it is chiefly tobacco, with occasional doses of alkohol—in Italy, it is garlic only; rosolios, which are spirits flavoured with different kinds of fruit, being rarely indulged in. In the better classes of society, our continental neighbours use strong coffee as an occasional stimulus: and this is worthy of imitation every where; though for torpid bowels, as I have already noticed, it is not so eligible for a constant breakfast, as well-harvested souchong tea.

But for persons of weak digestive powers, and feeble respiratory powers, where is a climate to be found without some objection? Extreme degrees of heat and extreme degrees of cold are alike overpowering in either case: and under these circumstances, prudence and discrimination may often adopt measures as beneficial to health in England as in any other country. The southern coast of Devon and the environs of Mount's Bay in Corn-

wall, are the most eligible parts of the island for atmospheric advantages in the winter season ; and if due regard be paid to dietetics, to clothing, and the regular offices of the alimentary system, much benefit may result from wintering there.

Italy, still the favourite portion of the civilized world, is deservedly resorted to, for the advantages of its climate ; while its universal interest to persons of taste and education, promotes a degree of mental excitation, no less beneficial to the hypochondriac, whose intellectual infirmities are constantly united with infirmities of the digestive organs. Still, however, those who repair to Italy under an expectation of avoiding all sudden and severe vicissitudes of atmosphere, will find themselves grossly mistaken. The great advantage of the reputed "halcyon climate" to the invalid, is that he has to endure an infinitely smaller proportion of general atmospheric severity : but that reduction of proportion neither reduces the suddenness of change, nor the sharpness of cold, nor the humidity and chilliness of fog and rain. The difficulty then, of travelling manœuvres in Italy is

to visit the respective towns in their best seasons : and although to this end, I shall make no attempt at laying down a standard plan, I may notwithstanding venture to offer certain hints which may not be unacceptable.

If Italy be entered from Switzerland, the towns of the plain of Lombardy will follow our visits to those of the Lago Maggiore and the Lake of Como. The former towns are intensely cold in winter, and at times much visited by fogs. At Milan, for example, I have seen fogs as thick and offensive as those of London. Lodi, Parma, Piacenza, Modena, and Bologna are bitterly cold ; and should be visited either before the winter becomes established, perhaps about October, or in the spring : for in decided summer, they are intolerably hot ; and on the approach of autumn, not uncommonly visited by intermittent fevers. The same remarks apply to the entrance from Savoy ; when Turin will probably be the first town visited : and if circumstances make one of the northern towns desirable for a residence of some length, I should certainly recommend Genoa, or Leghorn,

or some of the beautiful marine stations, between Genoa and Lerici. The former has a fine exposure to the sea, and is well backed by fertile and picturesque mountains ; while all the environs are exquisitely delightful. Leghorn is a peaceful and commodious place, with pleasing *contorni* ; and in every respect superior to the generality of commercial towns.

Midway the northern scale of Italy, comes Florence ; a place of which it would be difficult for praise or poetry to express the delights and advantages to all cultivated minds : but unfortunately, even Florence is too cold for some persons in the depth of winter, and is, upon rare occasions, visited by thick fogs. Still, with a little caution, the invalid may be vastly benefited here ; and the middle of January, or the beginning of February, commonly becomes sunny and genial. Why, or wherefore Pisa has been so much commended, I do not understand : it is cold, foggy, damp, and gloomy ; destitute of proper domestic accommodations, beggarly and repulsive.

Naples, besides its more southern latitude, has

perhaps the advantage of a less proportion of bad weather in the winter than most of the Italian towns ; but here the *Scirocco* is a powerful atmospheric enemy, and is apt to occur just as suddenly as any of our low humid temperatures in England : for example, after the whole month of March has been cloudless, summer-like, and renovating, I have found the wind change suddenly to the south west in the beginning of April, and the *Scirocco* prevailing under its characteristics of a clouded sky, and a humid, enervating, electric air, penetrating the very bones. This has been followed by intense cold ; Vesuvius covered with snow : fine weather has re-established itself for a week, and the *Scirocco* has returned for another week with all its vehemence. Prudence then, with regard to health, is as necessary at Naples as elsewhere when occasion demands it.

No person of delicate health should visit Rome earlier than the end of October or beginning of November, nor remain there after the end of April or beginning of May. The weather commonly becomes hot in May, and, with the accession of

summer heat, the *mal aria* begins to establish itself. Rome, therefore, is unsafe to all constitutions, not the most robust, during June, July, August, and September. The campagna of Rome, which, tradition informs us, was covered with cheerful towns, villas, vineyards, and gardens, is now a barren plain, exhaling mephitic vapours, the sulphureous qualities of which are half suffocating to travellers in many parts of the Appian Way, at an early hour of the morning, even in spring. Vine-grounds and gardens could not have existed without some considerable depth of soil ; but now the soil at best is extremely thin, meagre, and so superficial, that in many tracts it fails altogether, and the common rock mass of the country becomes exposed : this is of a volcanic nature, abounding with metallic and sulphureous salts, as is amply demonstrable, not only in the environs of Rome at large, but by the seven hills of “ the eternal city,” and also the Tarpeian rock. Substrata of this nature were sufficient not only to absorb and exhaust the nutritive qualities of superimposed cultivated land, but at the same time to influence

rapidly their general decomposition. I conceive then that the campagna of Rome gradually became unhealthy in proportion as the alluvial beds became exhausted, and as the exhalations of the metallic and sulphureous salts had a progressively greater opportunity of escaping. The vast tract of the Pontine Marshes also, ever had, and still has, its noxious influence. Further, within the walls of Rome, the exhalations from places of recent sepulture, to which I have already adverted, comes into the scale of unwholesome agents; and thus the *mal aria* of Rome is no enigma. The “mal aria fever” is in reality a form of intermittent fever, but, in certain respects, differing from the intermittent fevers of marshy districts in Great Britain. The biliary system is more severely affected, and in a manner resembling that which obtains under a tropical sun. The dull headache, the universal lassitude, the sense of heat and fulness of the eyes, as if bursting their orbits, the contraction of the features, the sense of emptiness, and distention of the stomach, which, while it craves something, loathes every thing; the dryness

and constriction of the skin, which, alternate with the more common febrile symptoms, all maintain a constant impression that a pestilential air is acting on the whole frame. The alimentary organs, and the sanguiferous systems are equally deranged. But few persons remain in Rome during the summer who have the means of leaving it; and the parchment skins, inflamed eyes, and general languor of those who do remain, sufficiently evince the common influence of the atmospheric annoyance. The fever itself is not contagious, but, like the intermittents of this country, leaves an habitual predisposition to its recurrence, so that some persons experience a regular annual accession of it. Tivoli is scarce sufficiently distant for a summer abode, but Frascati may do very well. From this beautiful and salubrious elevation, it is curious, under a clear summer sky, to behold the plain of Rome covered with a dense stratum of heavy vapour, as distinctly characterised as that of the *grotta del cane* near Naples, where the dogs kept in its vicinity for the witness of

visitants, are in less than three minutes thrown into pitiable convulsions. Why the campagna of Rome then is forsaken by cattle becomes sufficiently evident.

The *grotta del cane*, which is nothing more than a niche in the side of one of the volcanic hills surrounding lake Agnano, and running back about fourteen feet from a height of from five to four feet, the bottom being near about level with the borders of the lake, is remarkable for the distinctness of a stratum of carbonic acid gas from twelve to fifteen inches high, which it has naturally an opportunity of confining; but the same noxious vapour is escaping from broad surfaces over half Campania, and would exert more extensive bad qualities than it does, if it were not for the fortunate exposure of the country to the sea, and the alternation of soils of a more healthful, though still of a volcanic nature. The peasantry who, of necessity, inhabit the unhealthy spots of this country, attribute all their maladies to drinking bad water. That the water is considerably in

fault there is no doubt, but the air is in' still greater: this is particularly the case about Puzzoli, Cuma, and other parts of the "*Puteolana et Cumana regna*."

There are, however, numerous places about Naples where English families get through the summer without material inconvenience, but it would be better to remove to the opposite coast of Castellamare, which, while it has the advantage of an easy communication with Naples, has also those of a better summer aspect, and of standing on fine limestone elevations, well clothed with verdure, the only volcanic matters being such as have been deposited by the more rare and violent eruptions of Vesuvius, as when Pliny fell a victim to its fury, and Stabia was demolished in common with Herculaneum and Pompeia on the neighbouring shore.

British visitants who remain in Italy during the summer would do well to select some marine residence at least, since the most popular places are not the most healthy, for the reasons I have

adduced. For the sickly, who fly from a British winter, it unfortunately happens that the houses, both of Italy and the south of France, are altogether built and arranged with consideration to the heats of summer, and no provision against the cold of winter. Nothing is more irritating to weak stomachs and intestines than the sitting on brick or stone floors even when carpeted; and the enfeebled stranger should be prepared for a great reduction of domestic comforts and conveniencies generally. In this account, however, I do not include the beds, which, consisting of two excellent mattresses, and destitute of hangings, are infinitely more conducive to health than the contagious sacks of feathers which descend from generation to generation in English families. A wholesome bed, with the exception of blankets, may consist entirely of vegetable materials, for instance, a thick mattress of straw, or of dried leaves, collected from the autumn falls, with an upper mattress of cotton or hemp: much bodily relaxation and general derangement of health

would thereby be avoided, which those everlasting sponges of exhaled animal impurities, called feather-beds, are eminently calculated to promote. Travellers, when obliged to avail themselves of comfortless and uncleanly resting places, will find no small advantage from being furnished with sheets of thick chamois leather, which when placed under the linen, will prevent the accession to their persons of many latent impurities. Beds, like atmospheres, are among the external agents which physically influence the surface of the skin, and the skin influences all the internal organs.

Efflux and reflux of sympathies are perpetually in action throughout life, from the interior to the surface, and from the surface to the interior of the whole animal body. Of that whole, the stomach, according to my prefatory position, may be regarded as the central and primordial regulator.

Menenius Agrippa dispelled the prejudice of the Roman populace, by a fabulous allusion to the absurdity and blindness of all the members of the human body joining in rebellion against the

stomach: and if fable or fact could be adduced with such successful persuasion, to dispel the blindness of modern luxury, the stomach would not so perpetually be incited as it is to the contrary office, of waging war against all the members of the body.

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